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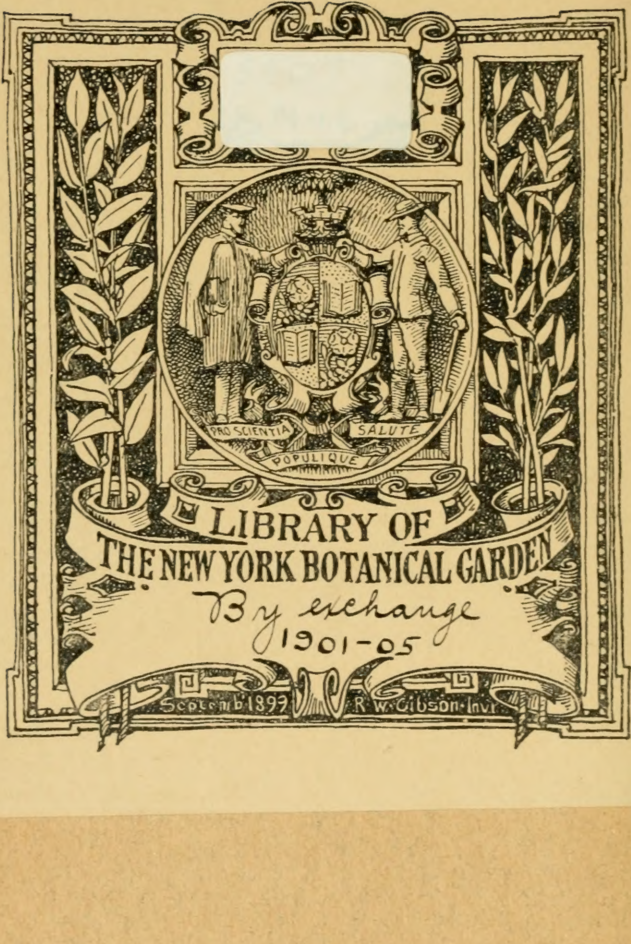

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REPORT

OF THE

BOTANICAL DEPARTMENT

OF THE

New Jersey
Agricultural College Experiment Station,

New Brunswick, N. J.,

BY

BYRON D. HALSTED, SC.D.,

For the Year 1901.

◆

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REPORT OF BOTANIST.

REPORT OF THE BOTANIST.

For the year ending November 30th, 1901, the work in the Botanical Department has been largely upon the two acres of the Experiment Area at the College Farm, supplemented with studies in the Laboratory and field work in various parts of the State.

As for the past eight years the experiments in the field have been largely devoted to truck crops, with less attention to tests of fungicides and more to the breeding of varieties of corn, beans, eggplants, tomatoes, cucumbers, squashes, etc.

Starting with a white and a black variety of sweet corn in 1899, a combination of the two has resulted in a few instances, the present season, in ears that were entirely with red grains. At the same time interesting points in plant-breeding have been obtained.

The crossing of a yellow variety of tomato with a red one has resulted in producing plants of remarkable vigor and a blending of qualities that may be of much profit. One of the results is a number of plants that are remarkable for healthy vine and fruits that are nearly seedless.

The work of combining two varieties of dwarf lima beans has resulted in an improved sort that is very promising. In this connection there have been reversions to the pole type that with these new crosses may prove advantageous.

The most immediate results in the crossing have been with the eggplants, and a new form has developed that may surpass all others in the desirable qualities in this vegetable fruit. All the crosses show a vigor and productiveness of plant that is very gratifying.

In cucumbers the progress in breeding for a spineless fruit has progressed ; many types are reached but none are fixed.

Squash crosses are showing some features of interest.

The testing of salad plants has been continued and the Swiss Chard and New Zealand spinach have shown much to recommend them for general use.

The hybrid salsify has bloomed and fruited this season and a good stand of plants for testing the quality of the roots next year is now upon the ground.

Observations upon the asparagus rust have been continued and additional facts determined with regard to its spread through the United States and its dependence upon the prevailing characteristics of the weather.

As usual the work with weeds has been the identification of foul stuff in commercial seeds and the observations upon the weed plot, which has been maintained for several years in a wild condition. The finding of broom rape upon clover and another species upon tomato are some of the weed events of the year.

A new greenhouse, 24 by 80 feet, was used for the first time last winter, and in it some results were obtained in germination, particularly as to albinism in corn, the dimorphism in buckwheat and the checking of mildews with various fungicides.

Some studies were made of the dodders, which as parasitic plants are often serious pests to clover, flax and other field crops.

One bulletin has been issued from this department since the last annual report was published; namely, June 1st, 1901, Bulletin 151, "Bean Diseases and Their Remedies," with four page plates, nine figures and twenty-eight pages.

The Station Herbarium has grown with the usual annual accessions from various sources.

In its many details the work at the Experiment Area and in the greenhouse has been, as formerly, in charge of Mr. J. A. Kelsey, and any success in results in crossing and spraying is largely due to his faithfulness.

The Experiment Area.

In the accompanying plan, Figure 1 shows the method of plotting the two acres known as the Experiment Area; it also locates in the plots the various crops that have occupied the ground the present season.

The seven series from 0 to VI. run up and down a slight incline of the field and are separated by four-foot paths, while the four plots, 33 by 66 feet, in each series extend right and left of the plotted page.*

To improve the soil, naturally a gravelly clay underlaid with yellow gravel, stable manure at the rate of twenty tons per acre has been added each spring during the past seven years. Last autumn nearly all the plots were sown to rye after the regular crop was removed. This made a good live cover that helped to hold the surface soil from washing in winter, but grew too rapidly in the spring, so that barley is used instead this season.

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* The plotting is given in full detail in the report for 1894, p. 279.

The Experiment Area.

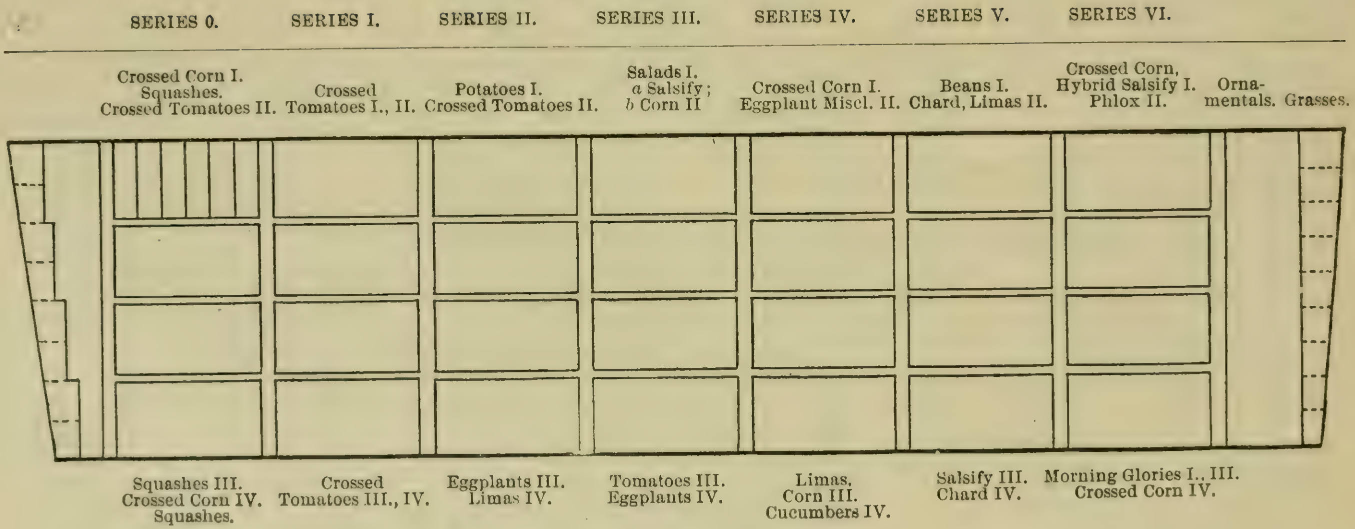
SERIES 0.
SERIES I.
SERIES II.
SERIES III.
SERIES IV.
SERIES V.
SERIES VI.
Crossed Corn I.
Squashes.
Crossed Tomatoes II.
Crossed
Tomatoes I., II.
Potatoes I.
Crossed Tomatoes II.
Salads I.
a Salsify;
b Corn II
Crossed Corn I.
Eggplant Miscl. II.
Beans I.
Chard, Limas II.
Crossed Corn,
Hybrid Salsify I.
Phlox II.
Orna-
mentals.
Grasses.
Squashes III.
Crossed Corn IV.
Squashes.
Crossed
Tomatoes III., IV.
Eggplants III.
Limas IV.
Tomatoes III.
Eggplants IV.
Limas.
Corn III.
Cucumbers IV.
Salsify III.
Chard IV.
Morning Glories I., III.
Crossed Corn IV.

Fig. 1. The Experiment Area in 1901.

EXPERIMENTS WITH TURNIPS—Concluded.

Series I., that had been in turnips for seven years, was set this year to crossed tomatoes. First, because the demonstration was made that lime is a satisfactory remedy for the club-root; secondly, turnips do not thrive as a continuous crop for many years, and thirdly, owing to the limited space, the land was needed for other experiments.

The reader who is interested in the club-root experiments, which were the chief reason for holding turnips for seven years and twelve consecutive crops upon the same land, will find the tabulations and conclusions upon pages 410–413 of the report of this department for last year.

POTATO EXPERIMENTS IN 1901.

Only Plot I., Series II., was in potatoes the present season, and this for the seventh consecutive year. The continuous cropping with potatoes is not advisable and was only indulged in for the sake of the experiments with soil fungicides for the scab. The results have not been uniform in these experiments, and while sulphur gave much promise the tests need to be many upon various kinds of soils before final judgment is rendered in the case. Owing to the demands of other lines of field experiments, mainly with plant breeding, the tests with potatoes must for a time be considerably curtailed.

Last season it was found that a shavings mulch gave a gain over the adjoining uncovered land of nearly as 5 to 3. With this in mind and the fact that the mulch seemed to protect the potatoes from scab, it was concluded to continue Plot I., Series II., in potatoes, although for the seventh crop, which would very surely be a small one. The early part of the season was unfavorable for potatoes and the crop throughout the State is only a fraction of the average.

The upper third of the plot was mulched with shavings that are purchased in bales of 100 pounds each and used for stable bedding. Fresh shavings to the depth of two inches were applied in July, and thereafter no cultivation was given to this portion of the plot.

The harvest was upon October 8th, and the following table shows the results in number of marketable potatoes, weight of the same and number of hills:

		Belt 1.	Belt 2.	Belt 3.	Belt 4.	Belt 5.	Belt 6.
Potatoes	Mulch	24	28	40	40	27	21
	No Mulch	76	36	78	45	47	28
Weight	Mulch	6¾	5½	11½	10¾	7	4
	No Mulch	17½	6½	17¾	11¼	9¼	5½
No. of hills	Mulch	14	18	19	19	19	18
	No Mulch	34	35	36	34	37	32

Total potatoes upon mulched ground 180, and upon the unmulched area 310. By bringing the two portions to the same size the relative numbers are : for the mulched soil 360 and the unmulched 310. The relative weights became for mulched land 91 pounds and 67¾ for the unmulched ground, a difference of nearly a half in favor of the mulched area.

The following table is of the amounts of scab, estimated as in former years, in terms of per cent. :

	Belt 1.	Belt 2.	Belt 3.	Belt 4.	Belt 5.	Belt 6.	Average.
Mulched	65	40	70	45	45	5	45
Unmulched	50	50	75	70	60	60	61

It is seen that the mulched land shows less scab, which may be due to the potatoes forming nearer the surface of the soil, sometimes even in the mulch, where there may be fewer scab germs.

EXPERIMENTS WITH BEANS.

Plot I., Series V., has been continuously in bush beans since the Experiment Area was started in 1894, with two crops for each season, excepting for the present year. Only two sorts, namely, "Green Flageolet" and "Saddleback Wax," were grown, they being planted in alternate rows upon May 16th. On account of the cold, wet weather, shortly after planting, the stand was not good with the first-named sort and the rows of the other were somewhat broken.

Upon July 30th it was recorded that there was much bacterial blight upon the "Green Flageolet." This is among the most susceptible of all the bush beans to this disease, but the alternate rows of the "Saddleback Wax" were not exempt. This last-named variety is but little inclined to the blight, and this selection of the extremes in susceptibility was purposely made in order to study this obscure point.

Microscopic examinations were made of the leaves and other parts of the two varieties, but enough evidence is not yet found to warrant any conclusion as to the exact reason for the great susceptibility in the one case and comparative immunity in the other.

The hope of a natural cross between the two sorts, by growing them side by side, was not realized, and the demonstration is made that, with plants like beans, where close fertilization is easy, and possibly the rule, one must resort to castration and the other accompanying details of hand pollination to secure a cross. Beans, peas and plants of that class are very different from corn, which crosses so readily that difficulty lies in keeping a variety pure when grown anywhere near another variety.

In another part of the Experiment Area, where the suspected crosses between the two above-named varieties of beans of last year were grown this season, there was considerable of the bean-pod spot (*Colletotrichum lagenarium* Pass.) upon the "Saddleback Wax." This is interesting as showing that this disease may appear upon a piece of land after it has been almost entirely absent for some years.

There was no record made of the yield of the two varieties, the comparative productiveness having been fully determined in previous years. The crop was such, however, as to confirm the opinion expressed before, that, under good culture and a fair degree of manuring, bush beans may be grown upon the same soil for at least eight years, with two crops in each season.

EXPERIMENTS IN CROSSING LIMA BEANS.

Last year twenty plants were secured as crosses between the "Henderson" and "Burpee" types of dwarf limas. The seeds upon all this score of plants were planted this year and the results are here recorded.

In a general way, it may be said that the vigor of the plants was satisfactory. There were many individual differences from the time the seedlings unfolded their first true leaves, and the plot showed those evidences of a mingled blood that plant-breeders find so difficult to set down in words. Some rows, that is, plants from one parent, were more uniform than others, favoring the "Henderson" or the "Burpee" as it might be. As they increased in age all of the hundreds remained true to the dwarf type excepting seven plants, and those were given poles and climbed, with one exception, with the vigor characteristic of genuine pole beans. It remains to be determined what the progeny may desire to do. In passing, it may be said that the future of these climbers is full of interest, for they represent a combination of qualities that may be of commercial importance. These plants are treated separately elsewhere.

In fruitage there is a remarkable constancy for all the twenty sets of plants adhere when quite closely to a type of pod and seed that make it easy to distinguish them from either of the crosses. It is not necessary to repeat in full the statement made in the report of last year, where a full page plate was employed to exhibit the cross in comparison with the pods of the two parents placed along side. The engraving here introduced will serve to show the characters of the seeds as shown in a small quantity of each.

Opportunity has come this season to test the quality of the cross, and it compares favorably with that of the "Burpee" and is far superior to that of the other parent. While not as large a seed as the "Burpee," it is large enough for a lima, and, when its yield is noted, the practical grower should be pleased with it.

The following is the result of the crossed plants for the year. Some parents produced only a few seeds last season and those from two out of the twenty failed to produce plants this season :

Parent.	No. of Plants.	No. of Ripe Pods.	No. Green, Filled.	No. Green, Empty.	Total.
1	Failed	....	....	....	....
2	2	2	35	3	40
3	3	13	37	....	50
4	1	5	11	....	16
5	19	425	46	5	476
6	20	592	65	18	675
7	70	1,200	325	40	1,565
8	1	9	17	....	26
9	72	1,227	338	95	1,660
10	32	775	85	40	910
11	33	570	55	21	646
12	5	193	44	....	237
13	29	705	305	25	1,035
14	28	940	165	15	1,120
15	46	995	131	10	1,136
16	Failed	....	....	....	....
17	21	332	25	10	357
18	69	1,597	312	80	1,989
19	16	560	210	30	800
20	5	96	35	10	141
Totals	472	10,236	2,241	40s	12,879

The average number of pods to a plant is 27.

A corresponding plot of ground was devoted to alternate rows of the two parent varieties and these harvested the following :

	No. of Plants.	Ripe Pods.	Green Pods.	Empty Pods.	Total.
Burpee	369	449	1,056	620	2,125
Henderson	700	3,550	340	350	4,240

It is seen that the "Henderson" produces about twice as many pods as the "Burpee" upon a given area, and this is due to the fact that the plants are smaller and may be grown closer together. Another fact is the earliness of the "Henderson," for four-fifths of the pods were mature, while less than one-fourth were ripe in the lot of "Burpee" plants. The average was six pods to a plant.

With the crossed plants, while the yield was 27 pods per plant, the matured pods made up five-sixths of the crop and the empty pods one-thirty-second of them all. In short, while the productiveness is more than four times that of the parents, the earliness is ahead of the "Henderson."

The relative size of the beans is well shown in the engraving (Plate I.), and the cross is seen to be nearer the "Burpee" than the "Henderson." In quality the same is true, and, while not as "rich" as the "Burpee," it is nearer to it in this important quality than the "Henderson."

The following eight plants were pole beans :

Parent.	No. of Plants.	Ripe Pods.	Green Pods.	Green, Empty.	Total.
13	1	24	2	14	40
12	2	64	35	107	206
15	2	61	130	60	251
18	1	23	42	57	122
20	2	209	355	132	696
	8	381	564	370	1,315

The two from the parent plant No. 20 are remarkable in their very large yield, one of them giving 404 pods and the other 292. Both are valuable stock for further growth, as these and all the other six plants are, of course, not like the parents, and become the starting points for new lines of breeding possible for pole limas.

EXPERIMENTS IN CROSSING TOMATOES.

Tomatoes were given much attention and space in the Experiment Area. From the large number of lots of seed saved from crossed plants of the previous season the following were chosen from red-fruited plants: numbers 6, 7, 17, 25, 32, 33, 52, 62, 84, 92, 97, 104, 144, 150, 168, 176, 178, 182, and from yellow-fruited plants numbers 98, 112, 113, 122, 125 and 126. The performances of these parent plants are given in full upon pages 431 to 439 of the report for 1900.

The whole of Series I. was devoted to the seedlings of these crosses and Plots I., II. and III. received the above numbers 6 to 182 and

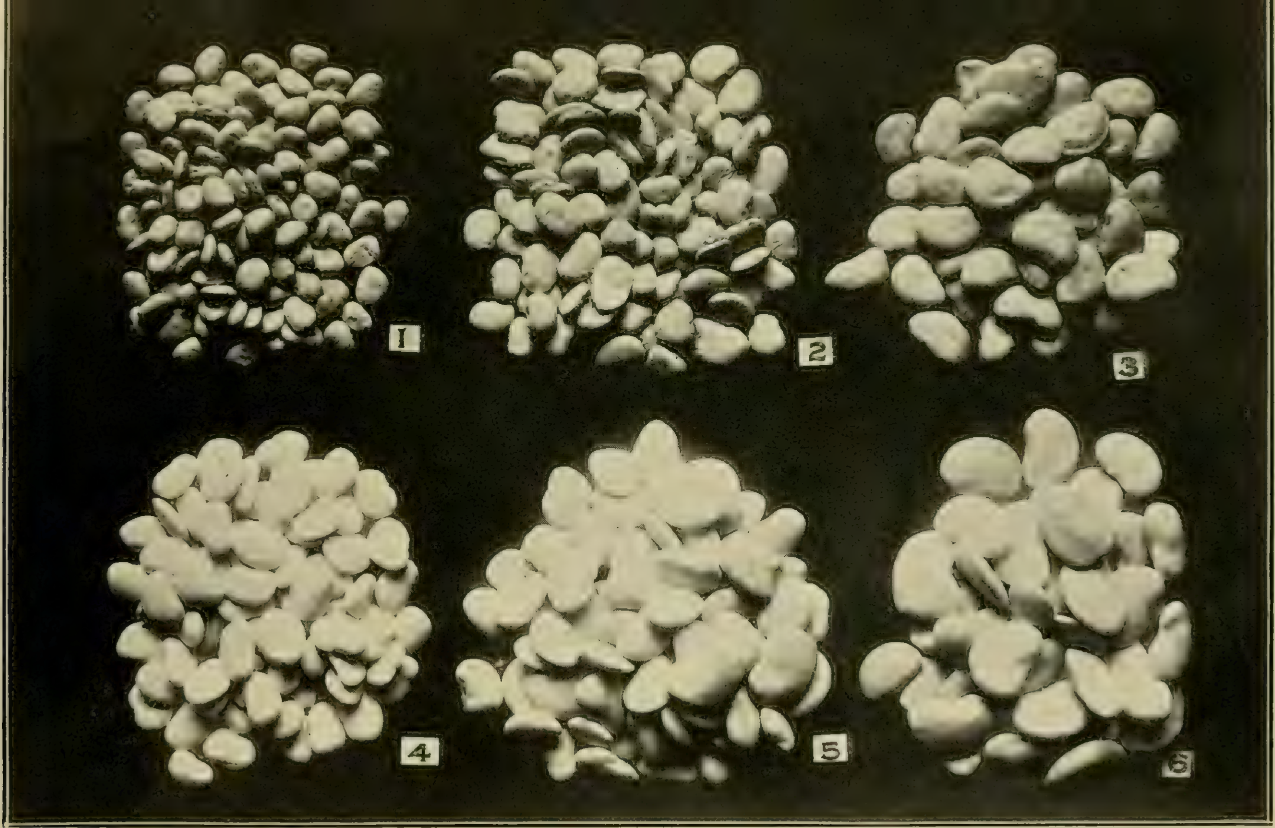

PLATE I.

Crossed Lima Beans Upper three dry seeds; lower three fresh seeds. Nos. 1 and 3 "Hendersin," Nos. 2 and 5 the Cross, Nos. 3 and 6 "Burpee", (size much reduced).

Plot IV. the six numbers 98 to 126. There were, therefore, three plots with plants from red fruits and one plot with plants from yellow fruits. Each parent number was assigned to a belt and was represented by ten plants.

The following table is made up from the results of each set of plants :

		Range of Fruitfulness.	Average Fruitfulness.	
Parent (Red) No.	6	48 to 120	84	Two Yellow.
	7	57 “ 125	98	“ “
	17	47 “ 110	78	“ “
	25	45 “ 128	84	No “
	32	39 “ 130	81	Two “
	33	72 “ 139	102	One “
	52	50 “ 102	79	No “
	62	29 “ 110	65	One “
	84	17 “ 125	79	No “
	92	40 “ 72	64	“ “
	97	42 “ 133	73	“ “
Parent No.	104	51 to 131	90	No Yellow.
	144	58 “ 143	85	“ “
	150	51 “ 188	108	One “
	168	28 “ 103	63	“ “
	176	66 “ 99	78	No “
	178	65 “ 140	96	One “
	182	48 “ 179	103	“ “
Parent (Yellow) No.	98	43 “ 92	61	Two Red.
	112	31 “ 105	60	No “
	113	39 “ 81	56	“ “
	122	40 “ 66	54	“ “
	125	36 “ 101	63	“ “
	126	22 “ 139	75	“ “

Plot IV., bearing the yellows, is perhaps the least congenial soil for tomatoes, and this may account for the somewhat smaller average for the last six lots of plants. The following table shows grand averages for the four plots :

		Average.
Plot 1	64— 90	77
Plot 2	78—102	90
Plot 3	63—108	85 5
Plot 4	54— 75	64.5

The full record of each of the 240 plants, considered in brief above, is kept on file, in which the time when each fruit was picked is given and the earliness or lateness of the plant, along with its productiveness, are a matter for reference.

Plant No. 67 of the 1900 crop was from a seed of a red fruit resulting from a cross of "Golden Sunrise" upon the "Dwarf Champion," and with a record of 83 fruits, all of which were below average size, but nearly free from seeds. The plant was unusually large and vigorous, so that it was dubbed "Giant," while the foliage had a mottled appearance, as if the differing green of the two parents had not fully blended.

Thirty-seven seedlings from the fruits of this unusual plant were set in Plot II., Series II., and the following is the record of the yield for each :

	August.				September.				October.		Ripe.	Green.	Total.	Color.	Foilage, &c.
	10	17	24	31	7	14	21	28	5	25					
No. 1	....	....	....	....	....	....	...	...	...	...	0	0	0		Thin. (See Pl. II.)
" 2	....	...	....	....	....	....	2	....	....	....	2	0	2		Normal.
" 3	...	...	...	1	....	....	2	1	3	1	8	0	8	red.	Thin.
" 4	...	....	....	...	....	....	....	....	....	....	0	0	0		Potato-like. (Pl. II.)
" 5	...	...	....	....	....	...	1	...	1	...	2	2	4	red.	Fruit plum-shaped. (Pl. II., 2.)
" 6	...	...	....	...	...	...	1	...	....	1	2	7	9	red.	
" 7	...	...	...	...	..	....	7	3	2	4	16	25	41	yellow.	Rank growth. (Pl. II.)
" 8	....	....	....	....	...	....	....	1	3	9	15	17	30	red	
" 9	...	....	....	....	...	....	....	2	4	4	10	20	30	red.	
" 10	....	....	...	....	...	....	....	....	3	...	3	0	3	red.	
" 11	....	1	....	...	....	....	...	....	....	3	3	4	7	red.	
" 12	...	....	....	....	...	....	....	....	....	....	0	0	0		
" 13	....	....	....	....	....	....	....	....	....	....	0	0	0		Erect, bushy. (Pl. II.)
" 14	....	....	2	....	21	9	23	14	9	14	95	60	155	red.	
" 15	....	...	...	....	....	....	....	....	....	....	0	0	0		
" 16	1	....	1	....	4	...	11	5	6	4	32	0	32	red.	
" 17	...	....	...	...	1	...	11	10	5	8	35	0	35		
" 18	....	1	...	1	16	8	30	14	10	14	94	45	139	yellow.	
" 19	....	....	5	1	16	11	44	16	12	10	115	42	137	yellow.	
" 20	....	7	2	4	21	4	46	29	8	5	126	8	134	yellow.	
" 21	....	....	....	....	....	....	22	....	....	....	22	37	59	red.	
" 22	....	2	....	6	7	2	15	11	2	4	49	0	49	yellow.	
" 23	....	....	....	....	14	...	....	....	....	....	14	0	14	red.	
" 24	...	....	1	3	19	25	65	80	120	80	393	13	406	red.	"Dulcamara." (Pl. II., fruit 3.)
" 25	....	....	....	10	....	13	33	20	6	3	85	13	93	yellow.	
" 26	....	....	....	....	....	....	...	....	....	....	....	6	6		
" 27	....	....	....	....	....	....	....	....	....	....	....	4	4		
" 28	....	....	....	7	7	2	2	9	20	10	57	13	70	red.	
" 29	....	....	....	1	6	6	14	5	12	8	52	18	70	red.	
" 30	...	....	1	....	....	1	8	7	12	2	31	2	33	red.	
" 31	....	....	...	4	8	4	10	4	2	1	33	0	33	red.	
" 32	....	...	1	10	12	1	7	2	3	9	54	15	69	red.	
" 33	....	....	1	....	6	3	8	....	4	6	28	15	43	red.	
" 34	....	....	....	....	26	2	16	11	13	22	90	22	112	yellow.	
" 35	...	...	1	....	7	3	13	4	5	16	49	40	89	red.	
" 36	....	....	3	3	15	1	15	3	2	2	44	4	48	yellow.	
" 37	...	...	3	3	7	....	10	9	10	4	46	8	54	red.	

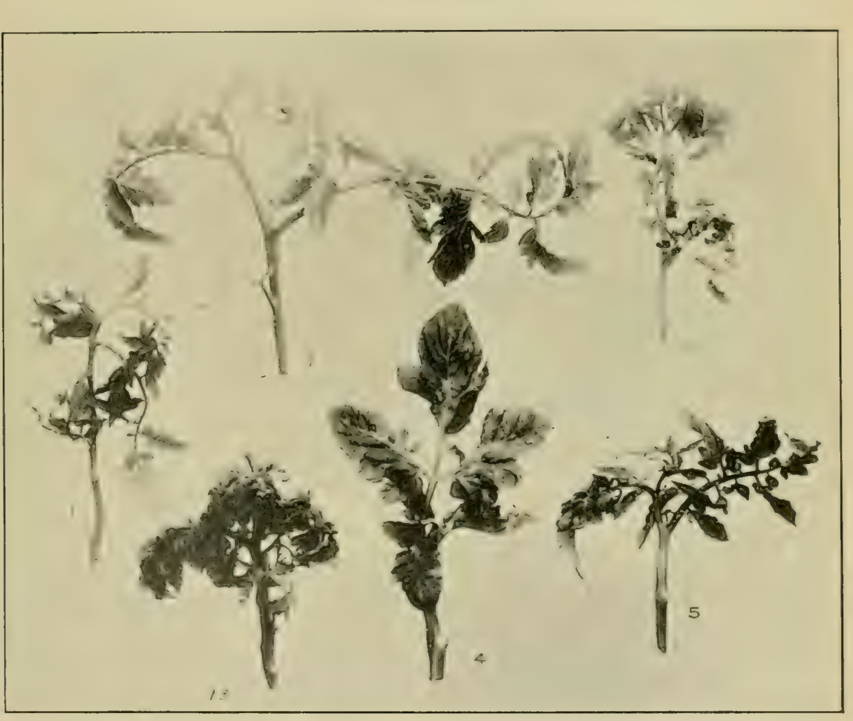

PLATE II.

Variations in Tomatoes—seedlings of No. 67. Stems and leaves No. 1, a fine nine-leaved, fruitless plant. No. 4, a potato-like fruitless plant. No. 5, an upright plant with plum-like fruit, nearly seedless. No. 7, a rank-growing plant. No. 13, erect-bushy fruitless plant. No. 24, a fine-leaved spreading plant, with small cherry fruit.

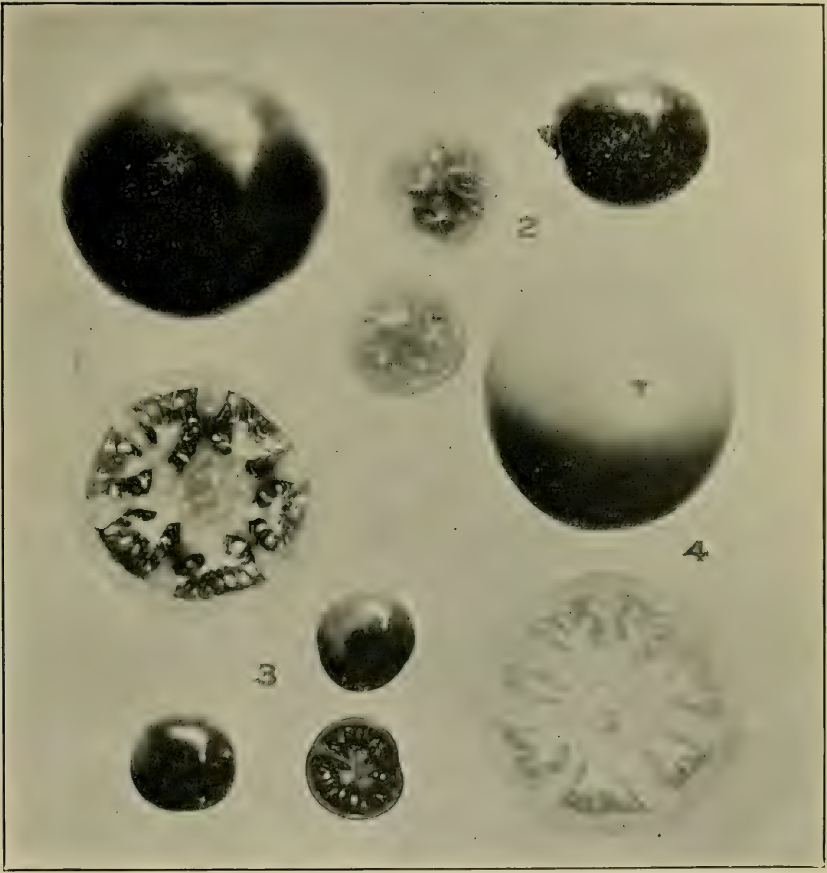

PLATE II.

Variations in Tomatoes—No. 1, an average red fruit, also in sectional view. No. 2, plum-shaped fruit, with nearly solid flesh. No. 3, the cherry tomato, with many seeds. No. 4, a type of the yellow fruits, and sectional view of same.

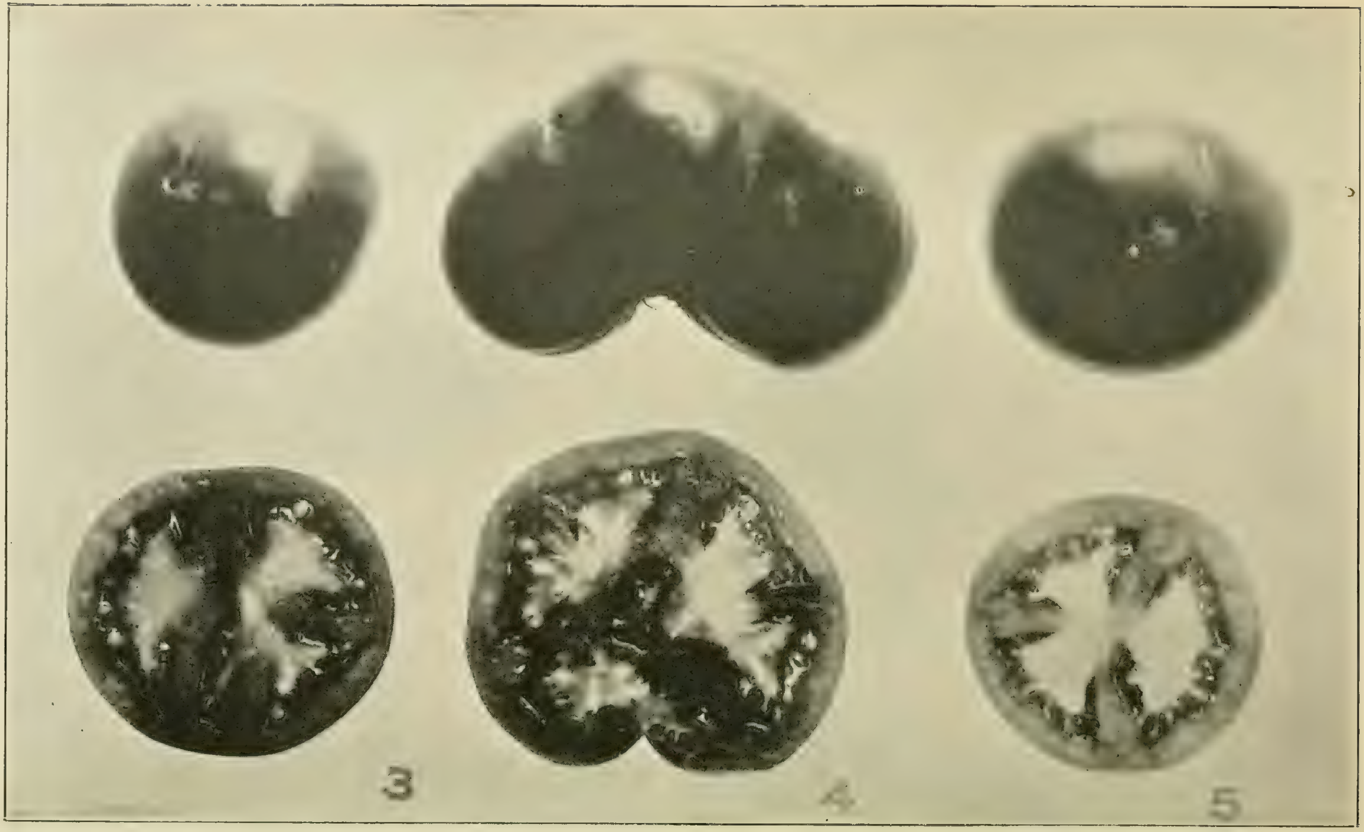

PLATE III.

Tomatoes from No. 177 of 1900 crop showing their nearly seedlessness as grown in the field (see Plate X. for those grown under glass)

It is seen that the number of fruits ranged from 0 to 406, ten were below ten and six were over a hundred. Some showed marked earliness and matured all their fruits, as Nos. 16 and 17, while others were late as Nos. 7, 18 and 35. Plate II. shows variations in the foliage and fruit of this lot of tomatoes.

Plant No. 177 of the 1900 crop was from a seed of a red fruit resulting from a cross of "Golden Sunrise" upon "Dwarf Champion," with a record of only 27 fruits, all small and with the seeds ranging from none to six to a fruit. This plant was remarkable for its great size, standing above the surrounding plants. The flowers were of unusually large size and added to the gigantic appearance of the plant.

Several of the seedlings from this plant were deformed and failed to reach much size, and only five specimens were set in the field, with the following results :

Lot 177.	Aug. 24.	Sept. 21.	Sept. 28.	Oct 5.	Oct. 25.	Total ripe.	Green.	Total.	Color.
Plant 1......	.....	1	2	1	8	12	4	16	red.
" 2......	.....	.....	2	2	1	5	1	6	red.
" 3......	1	3	.....	1	3	8	22	30	red.
" 4......	.....	2	1	1	9	13	12	25	red.
" 5......	.....	5	4	9	3	21	12	33	red.

These fruits were of fair size and many of them had but few seeds. The specimens photographed for Plate III. were from those that are interesting, because of their comparative seedlessness.

The plants all fruited late, there being only one fruit picked before September 21st, and the yield in all cases was small, ranging from 6 to 33 fruits. The fruits were all red and of fair size, with a small percentage of average seediness, and the plants were of the spreading "Sunrise" type, although not large.

Tomato Stock Plants.

One-half of Plot III., Series III., was kept in tomatoes for the eighth successive time, two rows to each belt, the "Golden Sunrise" and "Dwarf Champion" alternating with five plants to a row. The fifteen plants of "Sunrise" in fruitfulness ranged from 55 to 147, with an average of 91, while the "Champions" ranged from 32 to 149, with an average of 61.

As in former years the "Sunrise" is seen to be much the more productive sort, but being yellow is inferior as a market fruit ; but by those who have overcome the "color impression" the yellow is often preferred. The "Champion" comes into bearing earlier, and if green fruits were excluded from the record there would not be much in favor of the "Sunrise."

This crop shows that fair crops of tomatoes may be grown continuously upon the same land when the latter is kept in good tilth and the plants are sprayed, and all diseased fruits are promptly removed from the field.

EXPERIMENTS IN CROSSING CUCUMBERS.

From the crosses effected in 1899 between the "White Spine" upon the "White Pearl," twelve plants were grown last season. The characteristics of the fruit of this cross were shown in Plate II. of the report for 1900, along with those of the two parents. Seeds of the fruits of the above cross were used to fill Plot IV., Series IV., there being 36 hills.

Barring the severe attack of the beetles when the plants were small and saved from them only by timely vigilance, the use of insecticides, net covers and hand-picking combined, the plants made a fine growth and exhibited a vigor that was satisfactory. When the fruits appeared it was at once evident that the plot bore a motley lot of crossed plants. Many of them produced fruits of all degrees of color, from the clear white to a mottled, middle type and then on through all shades of green to the greenest that are produced. In size and shape the variation was no less, for some were nearly round, while others were long and slender. The type that was fairly uniform the previous year had been broken up in the second generation, quite in keeping with the general rule with crossed and hybrid plants.

In the midst of the season several of the more evident types of marketable size were selected for photographing, and Plate IV. shows the appearance of these in general form, but the shades of green are only unsatisfactorily shown.

One of the chief points in mind in this crossing was the removal of the spines, and this has been quite fully accomplished in some instances, while contrariwise other crossed plants produce fruits of remarkable roughness. For example, if one makes a comparison between Nos. 7 and 8 in the engraving (Plate IV.) with Nos. 14 and 15, he will be impressed with the spines upon the former and their nearly entire absence from the latter.

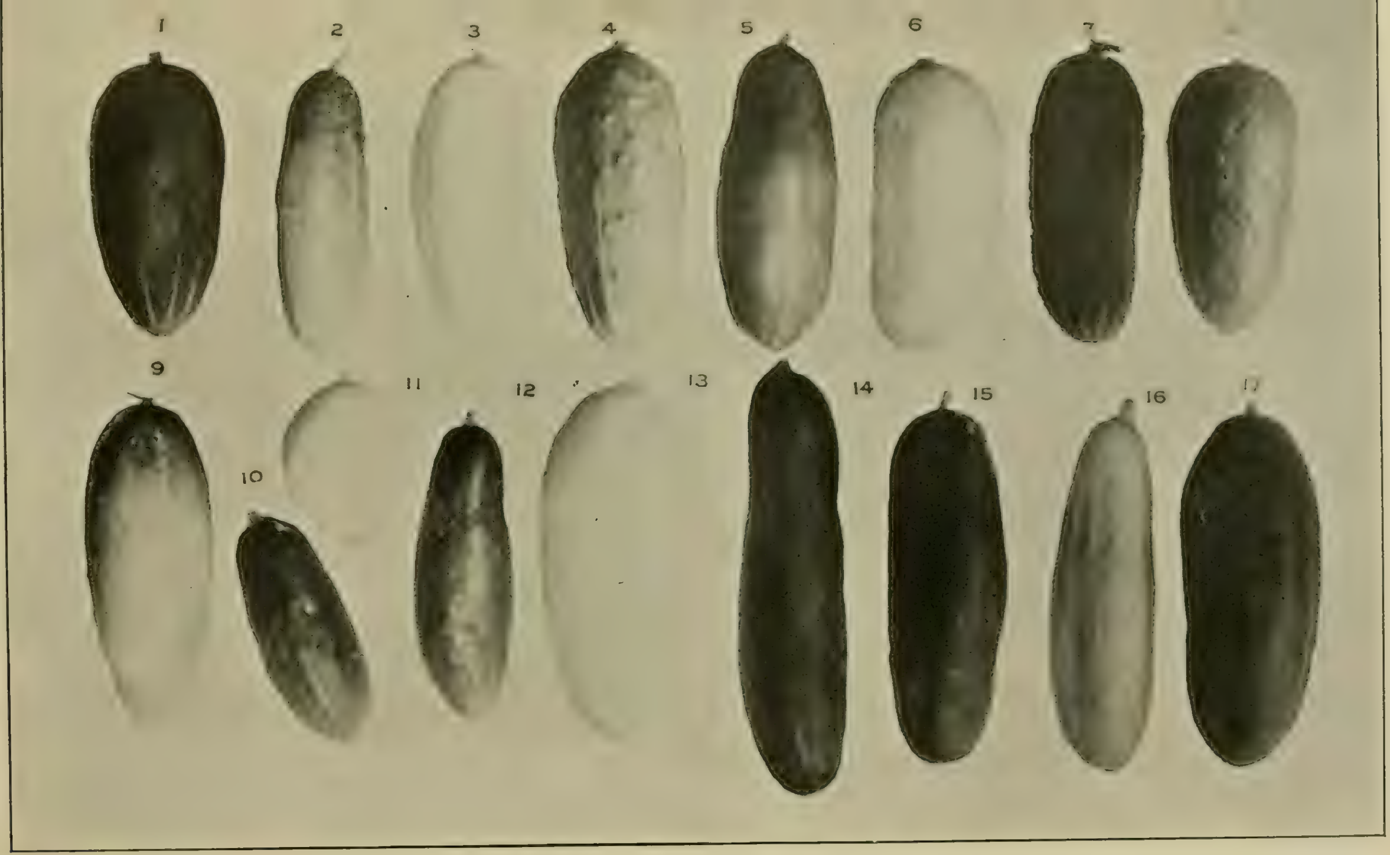
1
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PLATE IV.

Crossed Cucumbers. Types of fruits varying from the round white (No. 11) to the long green (No. 14). Some are very spiney (Nos. 7 and 8), while others are smooth (Nos. 14 to 17).

Notes on Cucumbers.

The following are some of the notes made September 5th, upon the specimens shown in Plate IV., taken in order, beginning with the first :

Number 1. Is a short, roundish specimen, peculiar in having a surface much mottled with white, and the blossom end quite pointed and ribbed with white. Nearly spineless.

Number 2. Is remarkable for its large spines, somewhat curved, rather uniform in size throughout, and decidedly triangular in cross section. Very green at stem end, and quite pale-green and ribbed with white at the blossom end.

Number 3. Is somewhat similar to No. 2 in the number of spines, but is a greenish-white throughout, somewhat curved, and decidedly triangular in cross section, and larger at the stem end.

Number 4. Is with few large spines, very straight and plump and rather short. A light-green, strongly ribbed with white from the blossom end.

Number 5. Has very few small spines. Is larger at the blossom end. A pale-green throughout, with the exception of a tendency to be white-ribbed from the blossom end.

Number 6. Is white throughout, with few spines, very plump and slightly curved.

Number 7. Is remarkable in being exceedingly spiny. Dark-green at stem end, growing pale and becoming yellowish-green at the blossom end, with a tendency to be ribbed and quite triangular in cross section.

Number 8. Is nearly the shape of No. 1, but, in addition, is exceedingly spiny, with a strong tendency to mottling, with a light green, quite sharp-pointed at the blossom end.

Number 9. Is nearly free from spines. Is broadly boat-shaped, with large blotches of whitish-green upon the green background, with a tendency to be ribbed from the flower end.

Number 10. Is with few spines, and a deep green color throughout. Strongly triangular in section.

Number 11. Is free from spines, oval-shaped, and white throughout.

Number 12. Is somewhat spiny, long, dark-green, and somewhat club-shaped.

Number 13. Is almost without spines, and white throughout. Very broadly boat-shaped, nearly straight, and very handsome.

Number 14. Is with few spines. Very dark-green and long, and somewhat club-shaped.

Number 15. Is nearly spineless. Dark-green. Straight and uniform in all respects throughout.

Number 16. Is nearly spineless. Pale, greenish-yellow color throughout, and inclined to be club-shaped ; somewhat triangular in section.

Number 17. Is with very few spines. Intensely dark-green in color, nearly uniform throughout. Slightly curved, and with little tendency to be triangular.

EXPERIMENTS IN CROSSING EGGPLANTS.

The results of the first year with seedlings from the cross of the "NewYork Improved Spineless" variety upon the "Long Purple" of the previous season have been fully considered the present year. The greenhouse permitted the growing of plants of various ages for setting in the experiment grounds. One lot was started so early that some of the plants showed their first bloom before they were set out, and an early crop of fruit obtained from these plants, followed by a second setting that corresponded in time with the main lot of plants grown at the usual time.

The cross was evident at a very early stage in the growth of the plants, first, from the uprightness of the "Long Purple" parent with the large broad leaf of the "New York Improved." There was the purple color of the young stems and leaf-stalk and mid-rib common to the "Long Purple," with the stoutness of the "New York Improved." Unusual vigor prevailed in the plants and a remarkable freedom from all leaf or root troubles, quite in contrast with plants of previous seasons upon adjoining plots. This was largely due to a more favorable year for this crop, as is proved by the check plants of both parent forms grown alongside of the cross.

When it came to the fruit the certainty of the cross was agreeably confirmed, because, instead of the long, slender and usually curved form of the "Long Purple," or the oval shape of the "New York Improved," there was a fruit that combined the characteristics of the two. In color it agreed closely with the dark purple of the "Long Purple," and is perfection in that respect for the peculiar demands of the market. In general shape it was like a slender pear of the "Bartlett" or "Louise Bonne" type, with often a little curve, which feature may be due simply to the position the young fruit takes between the ground upon which it rests and the branch above that bears it. While in weight it may not be heavier than the oval "New York Improved," it is often nearly twice as long, and therefore of a much superior shape for cooking. A large "egg" of the oval type is not well suited for the frying pan, while the new cross bears fruits that, when gathered at the right time, are just right for slicing and make pieces of the most convenient size for the table. The serious objections to the "Long Purple," as grown here for several years, has been their small size and lateness in coming into bearing and lack of fruitfulness. The quality is superior, and the small slices, when properly prepared, suggest strongly the oyster without their disagreeable features to those whose defective digestion is insufficient for the bivalve.

The "Long Purple" fruit has the seeds confined to its lower half, that is, in the free or lower end. In the "New York Improved" the seeds are more generally distributed throughout the fruit. The cross yields a long fruit, from which more than half of the slices taken are solid flesh, while the others are firm because the seeding tendency is not greatly developed.

The plants of this cross have proved of remarkable vigor, so great, in fact, that it has been suggested that for this reason alone the cross is a great gain. They began to yield marketable fruits by July 20th, while it was August 8th before fruit could be gathered from the "New York Improved." The crossed plants were practically one month earlier than the "New York Improved" and fully six weeks in advance of the "Long Purple." The latter were only beginning to flower by August 8th, and marketable fruits were rare until after September 10th.

The crossed and parent plants seemed to be equally affected by the fruit rot.

The greater gain of the cross is in the qualities found in the fruit already mentioned, namely, its perfect color, its desirable size and shape, being exceedingly attractive to the eye and permitting of convenient slicing for cooking, the large portion without seeds and possessing the high quality of the "Long Purple," with none of its defects.

It still remains to be determined whether the cross will maintain itself in the years to come. For the present, it can only be said that there has been but little variation from the shape mentioned. In fact, the whole lot of eggplants has yielded fruits as uniform as any of the old standard sorts the writer has seen. This does not preclude the thought that the second year may see many variations, so that selection and further breeding may be necessary to fix the type. If this is found necessary, the attempt will be made to lengthen the fruits still more, so that they may stand on end as they grow, with less surface upon the earth to induce decay or attract worms, while at the same time increasing the percentage of seedless flesh in a suitable shape for ordinary purposes.

Plate V. shows in the upper half the cross-fruit, in the center, with the sample of "Long Purple" fruit upon the left and the "New York Improved" upon the right. It was immaterial which parent bore the seeds in the cross, as the results were quite uniformly the same. There is little that needs to be said in addition to the preceding remarks, for the results are well shown in the engraving.

The lower half gives the same fruits cut longitudinally through the center, to show the texture and seed-bearing capacity of the three forms. It is seen that the middle fruit shows a much larger amount of solid, seedless interior than either of the parents. This is partly due to the increased size over the "Long Purple," from which parent it received the tendency to freedom from seeds in the upper two-thirds of the fruit.

EXPERIMENTS IN CROSSING SWEET CORN WITH RED GRAINS.

Plot IV., Series VI., was again planted to sweet corn. For seed, the pink grains were used from eight ears of the previous crop, and all having over ten rows upon the cob. The planting was upon May 14th, and the fruit harvest September 23d. The whole plot was remarkable for the vigor and size of the plants, which rank among the large-sized sweet corns.

The first thing observed in the results of the year's work upon this plot is the greatly-increased amount of the red in the ears. The table below gives the number of grains of each color for five average ears :

	Uncolored.	Black.	Red.
	69	21	342
	35	140	205
	43	115	322
	215	110	179
	82	21	257
Average.	90	81	261

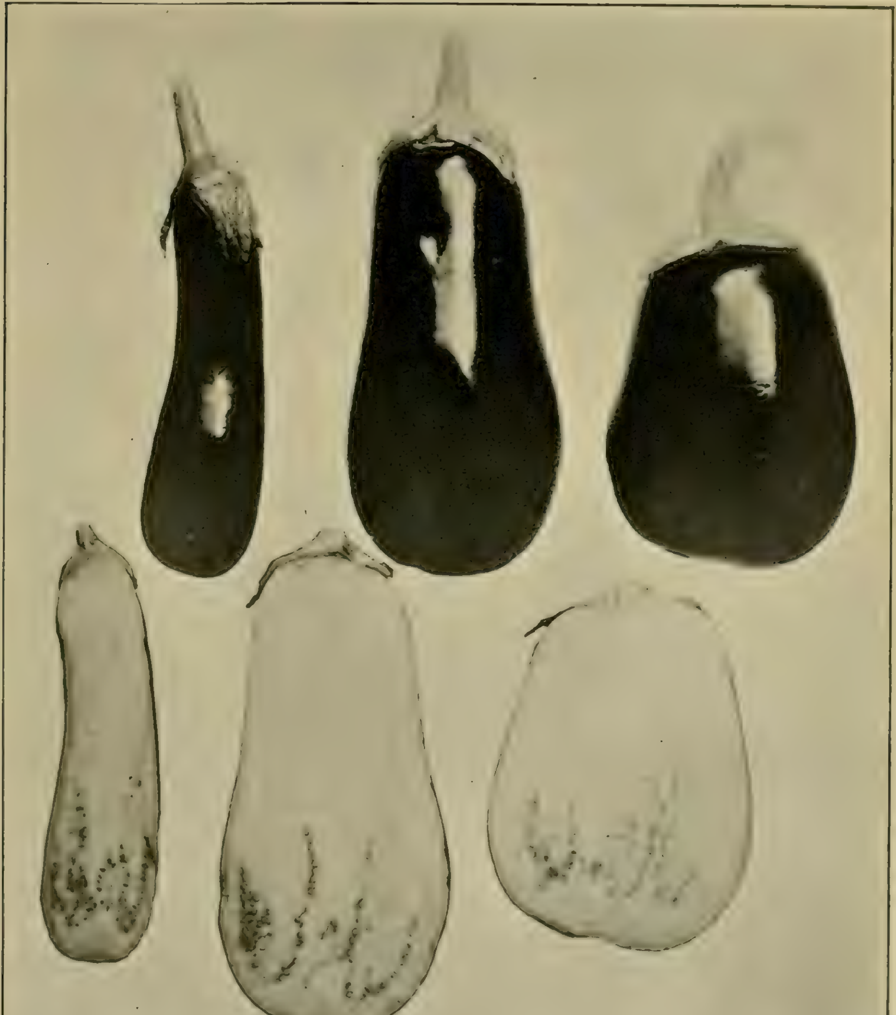

PLATE V.

Crossed Eggplants. Upper half is a surface view with section shown below. On the left is the "Long Purple," on the right, "New York Improved," and the Cross between them in the middle.

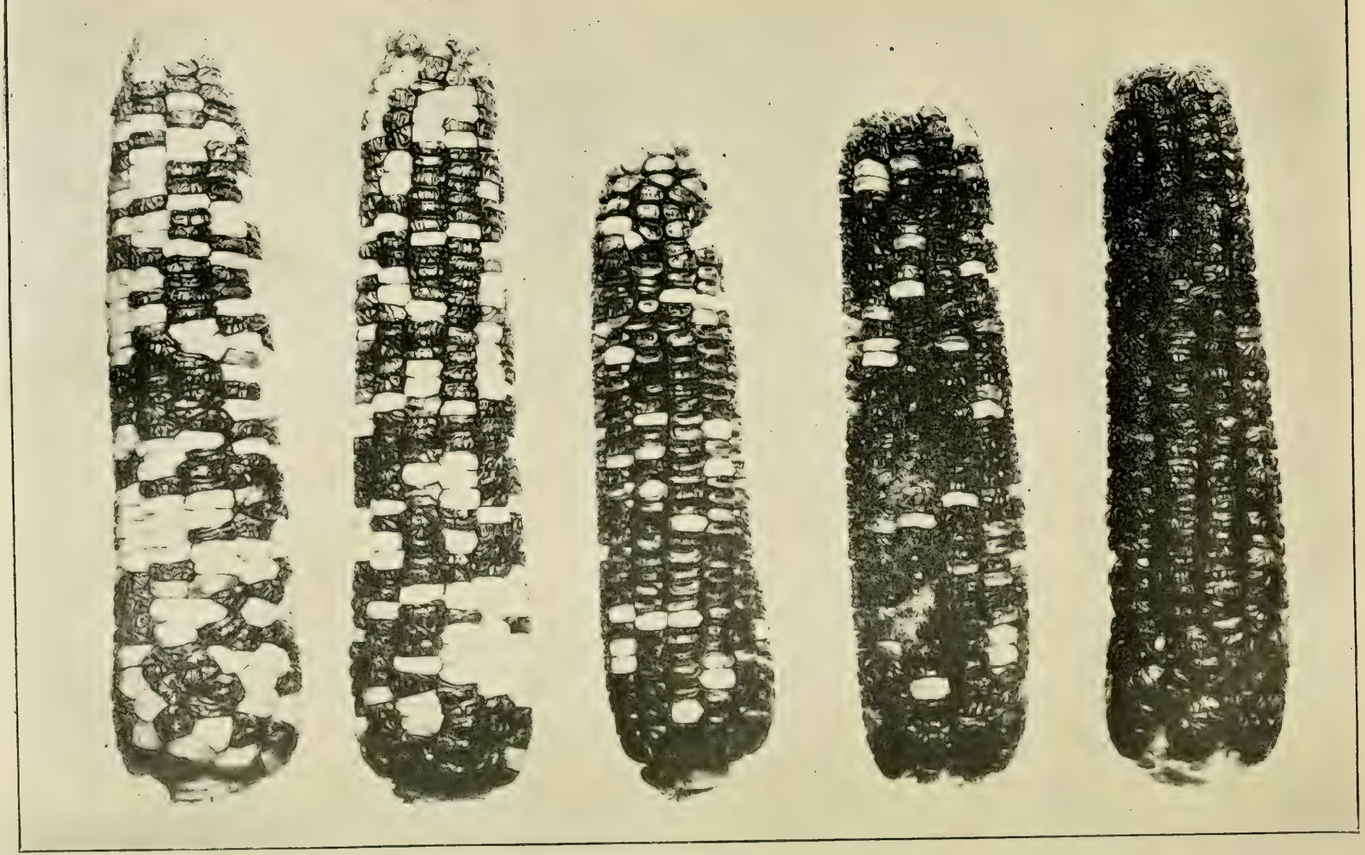

PLATE VI.

Crossed Corn. The ear upon the left shows those with most white grains; the one upon the right is solid red. The middle of the five ears is the average as to amount of white and colored grains.

A similar count made the year before for the crop upon the same land gave :

	Uncolored.	Black.	Red.
Average (1900)	172	121	92

It is seen that the number of red (pink) colored grains has greatly increased, of course at the expense of the uncolored (white) and dark (black) grains. There is, however, an increase in the actual number of grains per ear of 47—a feature of no small consequence when many rows is considered an advantage in sweet corn.

A second point to be observed, in a study of the ears as a whole, is the greater variation in them than last season. In 1900 the ears were practically alike, five of which were shown in a plate in last year's report. This season they range all the way from those with about half white grains to ears in which the color was entirely red. A representative group is shown in Figure VI., where the ear upon the left represents the extreme for white grains and the one upon the right for red ones. The middle ear is as near an average in regard to color of grains as may be selected.

It was noted at the outset that pink grains for seed were selected from ears with more than ten rows of grains. This selection may have influenced the ears, for nearly all of them are more than eight-rowed, and in this respect the "Black Mexican" type is largely lost from view. Ten per cent. of eight-rowed ears are still met with, but such ears seem to have no greater percentage of dark grains than others.

A noticeable feature this season is the number of ears that have only two sorts of grains, namely, the uncolored and a pecular bluish kind, that may be styled "lead-colored." That these ears have come from the darkest pink grains bordering upon purple is almost proved in other plots, where the so-called "black" grains were planted to determine the power in reproducing their kinds. This part of the subject is considered elsewhere. Some of the ears are mixed purple or "lead-colored" and white, and others are entirely of bright pink and white. In short, there are all variations between the two types named, which shows the great power each grain has of producing grains like itself, and this leads one to place great importance upon the selection of just that type of grain that is desired in the product. If this work of crossing corn had no other output than the enforcing of this underlying principle of plant improvement, it would not be fruitless indeed. The results are so rapid and cumulative that every grower should look upon his seed as the factor in his work, largely under control, that makes for success or failure, as the case may be.

Plot I., Series 0, was devoted wholly to corn for the present season, excepting some late-planted squashes and cucumbers. The seed used was pink grains, selected from a dozen well-shaped, eight-rowed ears from Plot IV., Series VI., of the previous year. The harvest was concluded upon September 27th, and, upon making a close comparison with that of Plot IV., Series VI., previously reported, there was no difference to be found in the percentage of the various colors of grains, so that what was there stated holds with equal force here. The only difference between the two plots was that of the rows of grains upon the ears used for seed. Excepting this, that the plot now under consideration is a higher piece of land and not so rich in plant-food, and while there was not a great difference in size of plants and yield, they were in favor of the Plot IV., Series VI.

The following table shows the types, in rows, for one hundred ears for three plots, where the seed ears varied in number of rows :

	8-rowed seed.	10-rowed seed.	Over 10-rowed seed.
No. 8-rowed ears	26	36	21
“ 10 “ “	46	25	44
“ 12 “ “	27	37	31
“ 14 “ “	1	2	4
	100	100	100

	Average.
No. 8-rowed ears	28
“ 10 “ “	38
“ 12 “ “	32
“ 14 “ “	2
	100

From this it is seen that the greatest number of 8-rowed ears was from 10-rowed seed and the greatest number of 10-rowed ears was from the 8-rowed seed. The greatest percentage of 12-rowed ears was from the 10-rowed seed and the majority of the ears with over 10 rows was from the ears with 12 to 14 rows. Out of this single test one would not get much light upon the method for selecting for definite type as to number of rows to the ear. This is a feature in cross-bred corn that is quite different from that in color, for it is more deeply seated than mere color of the grain, that may be influenced by the cross. While the "Black Mexican" is an 8-rowed variety, the "Egyptian" has no fully-established number over 8, and this variety has had a preponderance of influence upon the rows in the ear, as the table above indicates, where nearly three-fourths of the ears are with more than 8 rows. The same stalk may bear an 8, a 10 and a 12-rowed ear, showing that circumstances determine the number upon the same plant, and these may be entirely outside of the combination of the cross.

Plot IV., Series 0, was planted again to corn, this time with pink grains from 10-rowed ears. There is little to be added to what has been said concerning the results upon the two other plots planted with similar grains. There was quite a uniform increase of the pink grains over that of the previous year, and some ears were found with only red grains. The fact that grain for 10-rowed ears had no marked tendency to produce 10-rowed ears is mentioned elsewhere in tabular form. In this instance there were more 8-rowed and 12-rowed ears than those that were 10-rowed, like the parent ears. Several records of similar observations are necessary for the formation of any general rule that may hold in these cases.

A portion of Plot I., Series VI., was set with corn started in the greenhouse. The seed did not differ in kind from that used in the plots above mentioned. The corn did not grow for some weeks after being set in the field and made a small growth, but was a week or so earlier than in the other plots. The percentages of red grains and the number of rows to an ear were not different from those elsewhere. There was no decided gain in anything by thus starting the corn indoors and setting it out when four weeks old.

With White and Black Grains.

Plot I., Series IV., was planted to corn on June 28th, purposely late, to avoid mixing with the plots receiving the pink grains. The seed used was the white and the black grains from ears with over ten rows, the pink grains of which had been planted in Plot 2, Series VI.

The six eastern rows of the plot were planted with the white grains and the western six rows with the black grains. All else was in common, excepting that six of the white hills were covered with small tents at blooming time, and these are reported upon elsewhere. There was no difference in the plants between the two halves of the plot while growing; that is, the size of stalk, time of blooming, and color of leaf, were uniform.

The harvest was made on September 30th, and an average sample ear selected from each row. The outermost row planted with white grains showed about twenty per cent. of the dark grains, while the outside row, planted with black grains, gave practically the same number that were either white or off of the black color. Rows six and seven were adjoining, and upon the row planted with white grains the white predominated, and upon the other row the black led. The number of each color was as follows:

	White.	Pink.	Black.	Total.
Ear from white seed	330	33	93	456
Ear from black seed	178	49	193	420

It is seen that, while the mother plant controls the color, this is much more evident with the white than the black color. No notes were made upon the prevailing winds at the time of blooming, which might have favored one or the other side. The well-known fact of the readiness with which corn will cross finds a good illustration in the present instance.

Some of the grains, ranked as pink in the tabulation, are speckled or marked with bars of color; occasionally a half of the grain only is purple, so that some ears have a wide range of grains, in this respect indicating an unsettled condition of things.

A count was made of the best ears throughout the plot, and the following are the numbers for the various rows upon the cob:

	White seed.	Black seed.
No. of 8-rowed ears	15	15
" 10 " "	42	41
" 12 " "	58	74
" 14 " "	4	6

This shows a very large percentage for the 12-rowed type.

As the seed used in the plot is from the same ears as that for Plot IV., Series VI., all being over 10-rowed, a comparison with the harvest of that plot may be interesting, for which facts see previous page.

Inbreeding of the Crossed Corn.

During the present season an attempt has been made to inbreed corn. Of the lot of corn transplanted from the greenhouse to belts 1, 2 and 3 of Plot I., Series VI., five separate hills were thinned to a single stalk shortly before the time for the tassel to appear, and

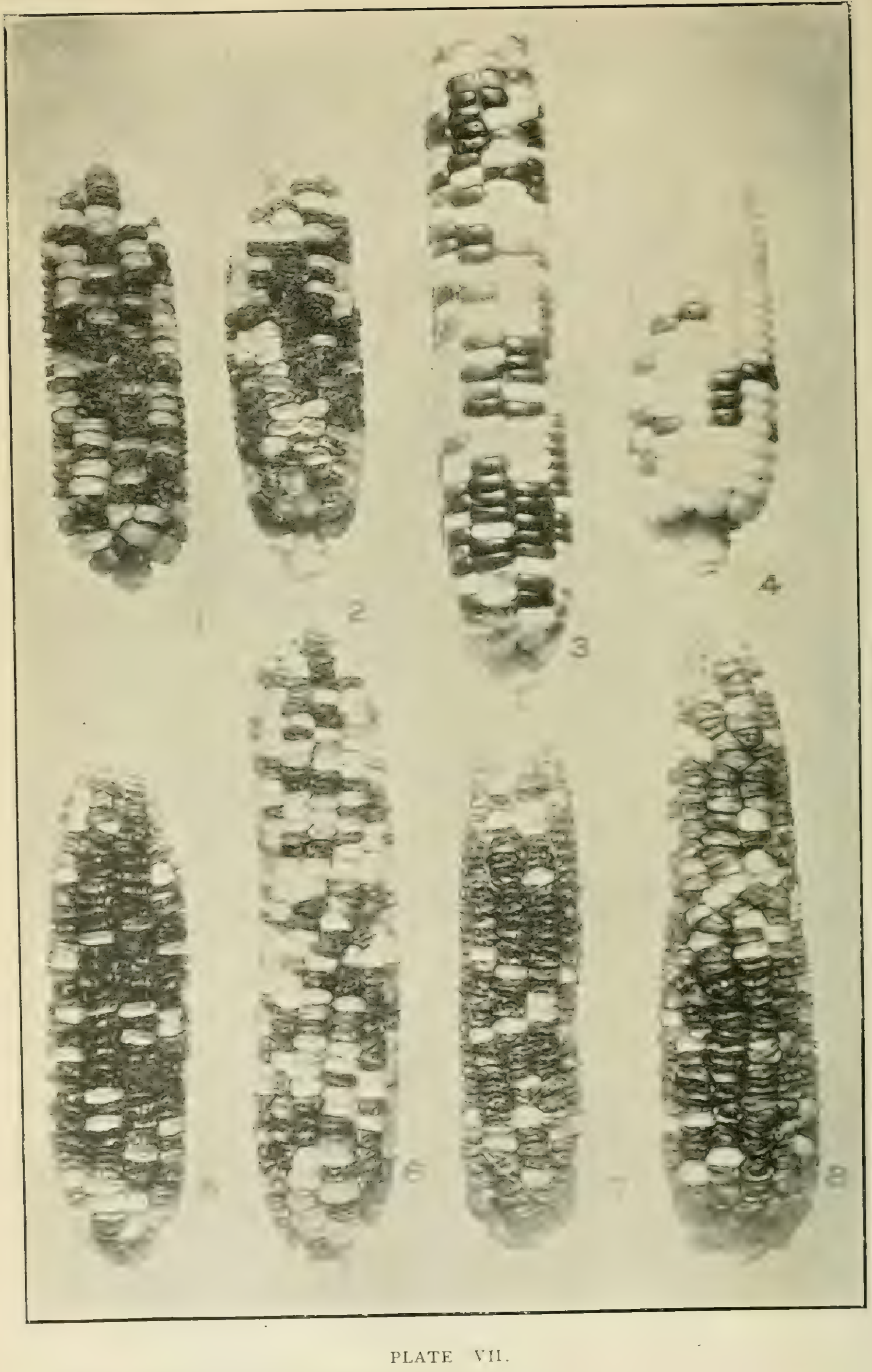

PLATE VII.

Inbred and Wide-bred Corn. The upper row shows inbred ears, Nos. 1 and 2 dry, and Nos. 3 and 4 green. The lower row shows ears from detasselled stalks.

covered with a "tent" made of cloth tacked to stakes that were driven in the ground. These "tents" were triangular, one foot upon each side, and everywhere made, as it seemed, pollen proof. In these enclosures the stalks remained for three weeks, the only attention given them being an almost daily jarring, to assist in the fall of the pollen that of course was shut in from the ordinary winds moving around them.

It was observed during the time the "tents" were in use that ordinary stalks in the open, comparable in every way with those covered, matured much more rapidly. While it is, for example, a well-observed fact that the tassel begins to show pollen in its lowermost branches some two or three days before the silks of the same stalk appear, in the confined stalks this period was increased to a week or even ten days. It was also noted that the silks of the "tented" stalks kept green and apparently receptive for a time, far exceeding that of the surrounding corn. Last season an experiment was made upon the duration of fresh corn-silk by removing all the tassels from a plot planted late, and therefore in bloom after all surrounding plots of corn had gone to seed. It was then demonstrated that silk deprived of pollen did not only grow to enormous size, but kept green for two or three times the normal period. The "tented" plants behaved in the same way as if the pollen did not reach it promptly, and this is probably true because of the confined condition of the plant under treatment. Good ears, however, did finally form in the "tents," as may be shown by those figured in Plate VII. No. 1 is as an ear from the corn started in the greenhouse above located in the field. No. 2 is a similar ear from a plant "tented" in the same way as before noted, but in Plot IV., Series VI., where the seed grain was planted in the field. These ears are both short, but well filled out with normal grains and with an admixture of white and pink and all the aspects of the ears of the crop of the previous season. In No. 3 is shown an ear obtained by covering the young ear before blooming, with a paper bag, while the tassel had been similarly treated some days before. When the silk was ready the bag containing the tassel cut from its stalk replaced the one that had previously protected the young ear. The latter large bag was kept in place until the corn had set. There seems to be very little opportunity of foreign pollination. The ear shown, one of several, is of fair size and is from a stalk that grew from a very dark grain. The mixture of grains is more distinctly black with white, not well shown in the engraving, as the photograph of this No. 4 being taken when the ear was freshly picked and the grains were plump. No. 4 differs from the preceding only in being from a white grain of the mixed corn, and nearly all the ear is of the same color.

There were seventeen separate stalks placed in "tents" at different dates, and a majority of them produced ears, while others failed, probably because a mould attacked the pollen during a wet spell. So bad was this upon some stalks that it is a wonder that any ears formed, The "tents" might be improved by being extended a foot or more above the tassel and a larger diameter of the whole would add needed space.

The conclusion seems to be that inbred corn reproduces the peculiarities of the stock ; that is, a pink grain from a mixed ear produces a mixed ear, but at the same time a black grain from the same mixed ear shows an increase in the black and a white grain an increase of the white. The immediate parent, while having an influence, does not control the offspring.

Wide Pollination in Crossed Corn.

As opposed to the tests in inbreeding, at the same time that stalks were placed in "tents," certain others in the same plots and closely comparable with them were detasseled, and therefore the possibility of inbreeding destroyed.

Ears Nos. 5, 6, 7 and 8, in Plate VII., are from such castrated stalks from four different plots. In this instance it seems evident that the removal of the tassel at a time when it is issuing from its coil of leaves is injurious to the plant. With the exception of No. 6, none of the ears shown are first-class. The cut stalks seemed to brown at the top and cease growing, and, of course, they lost some leaf surface by the decapitation. None of the ears filled out well and were not even in breadth, as is evident in Nos. 7 and 8. All four ears shown were from the same stock of pink grains and they do not differ in percentage of pink and white grains from those grown normally around them. No. 6 is somewhat lighter than the average and the other three are perhaps a trifle darker, so that a fair average is maintained.

Nothing in this test goes counter to the generally accepted belief that pollination between different plants is the rule with corn, for which there is ample provision in the high position of the tassel, the great abundance of dust-like pollen and the silks of any given plant maturing somewhat later than its own tassel.

Breeding of Corn for Prolificness.

A half plot (in Plot III., Series IV.) was planted late, June 28th, with the pink grains selected from the seven ears taken from three stalks grown in Plot IV., Series VI., of the previous year. One of the stalks bore three fine ears and the other four of the seven ears were first-grade twins. There were but few triplets in the original plot, while the twins were not rare. The triplet had two ears, with ten rows of grains and one ear with fourteen rows. One of the twins had eight and ten rows to the ear respectively, while the other pair were both 12-rowed. Therefore, of the seven ears one was 8-rowed, three were 10-rowed, two 12-rowed and one 14-rowed, or an average of eleven rows to the ear.

The corn made a fine growth of stalk, and in size it was entirely satisfactory in this respect. Owing to late planting the season was shortened, but the absence of early frosts favored the experiment, and the corn was harvested upon October 13th, at which time the grains on many ears had begun to shrivel.

There were six rows of eight hills each, or 48 hills, carrying 144 stalks, omitting the many "suckers," some of which grew tall and produced small ears not considered in the count. There were 44 stalks with single ears, these being unusually large and invariably with ten or more rows of grains. Eighty-three stalks had two large, marketable ears, with rarely less than ten rows, and one was a pair of 16-rowed ears. There were 17 with three or more ears, among these being one stalk with five ears, all over five inches long, and one with six and another with seven ears, but of these only one or two were marketable. The tendency to produce ears had thwarted the end and stalks had formed, which were not at all desirable.

The table of the number of rows to an ear for seven sets of triplets :

	Stalk 1.	Stalk 2.	Stalk 3.	Stalk 4.	Stalk 5.	Stalk 6.	Stalk 7.	Total rows.
Upper ear...........	8	12	8	10	10	12	8	68
Middle ear.........	12	8	10	10	10	12	10	72
Lower ear..........	12	8	12	10	8	12	8	70

This shows that the average number of rows does not vary much for each position upon the stalk. The upper ear may have the smallest number of rows, as in No. 1. or the largest, as in No. 2. The number may be the same for all the ears, as in Nos. 4 and 5, or the middle ear may have the largest number, as in No. 7. The average number for the twenty-one ears tabulated is exactly 10, which is one row less than that in the lot of seven ears that furnished the seed for the planting. This is true, however, that the ears borne singly in this lot gave a higher average than the triplets above tabulated, and the same is true of the pairs of ears, so that the average of the number of rows is brought up to fully that of the seed ears, and the experiment shows clearly that the grains from ears with many rows have a tendency to produce ears similar to those furnishing the seed.

This is only an incidental fact, and the still more important one is the exhibition of the tendency to ear formation. This is made more evident when it is stated that upon all the other plots of corn in all 432 hills, not a single triplet was found, and comparatively few twins. In order to get the required amount of the ears desired no attempt to use twin ears was possible. It is regretted that the number of twins was not recorded, but, as stated, they were not common. On the other hand, in the half plot in question, where two twins and a triplet were used for seed, the number of ears was 272, or nearly an average of two ears to the stalk, exclusive of many "suckers" that sometimes eared at the tip in a cluster of grain-bearing spikes.

FURTHER OBSERVATIONS UPON SALSIFY HYBRIDS.

In the report for last year (pages 445–447) the results up to that time are given upon the work in the crossing common garden salsify, or "oyster plant," *Tragopogon porrifolius* L., with the wild species, *T. pratensis* L. The hybrid plants, twelve in all, seeded sparingly, and these seeds were sown in Plot I., Series VI; but owing to the unfavorable dry weather the autumn growth was not as it might have otherwise been. The seeds from each hybrid plant were sown in separate rows, that any differences in the offspring might be noted.

The two parent species, while agreeing closely in many things, are strikingly different in the color of the flowers, those of the cultivated salsify being light violet red violet*, while that of the wild species is deep yellow.

It is seen, therefore, that in one parent the floral colors are a mixture of violet and red, the violet predominating, while the other is a simple yellow. There are two types of the crossed plants as regards the color of the inflorescences, namely, (1) with both the ray and the central flowers all colored alike, darker red, red violet, and (2) those with only the ray flowers, the above color, while the smaller central flowers are yellow, excepting possibly the tops of the ligulate corollas; in short, the central flowers closely agree with those of the male parent. This second type favors the wild species, and the first type approaches the cultivated form. There were no intermediates between the two above types. It is seen that in the crosses the violet has diminished, while the red has greatly increased and the yellow is scarcely in evidence in one of the types.

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*In this record, Prang's color chart is employed.

Plants in large numbers from these hybrid seeds have been observed this season, and the range in colors is a wide one, no less than thirty-five of those in Prang's list being present.

Starting with the red end of the spectrum, the number of blooms examined at two different dates (June 1st and 8th) follows the name given to the color matched with the flowers.

	Color chart number.	Color.	Abbreviation.	June 1.	June 8.	Total.
	11	Darker red	(R-dd)	7	16	23
	12	Dark red	(R-d)	7	6	13
	22	Dark red red orange	(RRO-d	1	...	1
	31	Darker red orange	(RO-dd)	4	2	6
	41	Darker orange red orange	(ORO-dd	6	3	9
	82	Dark yellow yellow orange	(YYO-d	1	...	1
	83	Yellow yellow orange	(YYO)	1	...	1
	92	Dark yellow	(Y-d)	1	1	2
Parent	93*	Yellow	(Y)	5	5	10
	94	Light yellow	(Y-l)	6	6	12
	95	Lighter yellow	(Y-ll)	2	4	6
	101	Darker yellow yellow green	(YYG-dd)	1	...	1
	212	Dark violet	(V-d)	1	...	1
	213*	Violet	(V)	3	...	3
	214	Light violet	(V-L)	2	...	2
	215	Lighter violet	(V-Ll)	1	...	1
	222	Dark violet red violet	(VRV-d)	...	...	...
	223*	Violet red violet	(VRV)	13	10	23
Parent	224	Light violet red violet	(VRV-L)	23	12	35
	225	Lighter violet red violet	(VRV-Ll)	14	15	29
	232	Dark red violet	(RV-d)	1	1	2
	233*	Red violet		3	2	5
	234	Light red violet		4	5	9
	235	Lighter red violet		...	...	...
Hybrid	241	Darker red red violet		3	...	3
	242	Dark red red violet		1	2	3
	243*	Red red violet		1	1	2
	252	Dark orange gray		1	2	3
	253	Orange gray or brown		3	...	3
	331	Darker red gray		1	...	1
	333	Red gray or russet		3	...	3
	354	Light yellow gray		1	...	1
	375	Lighter blue gray		1	...	1
	382	Dark violet gray		6	...	6
	384	Light violet gray		1	...	1

It is seen that the color of the *T. porrifolius* has the largest number, with its nearest neighboring shades as next largest. The dark reds follow closely. In short, the violets and reds predominate, while in the yellow there is a fair showing.

During the present season the seedlings of no one mother plant differed in any particular way from others. They all showed equally the wide variation in the colors of the flowers that has been detailed in the table.

The piece of ground bearing the hybrids is left with the plants to self-seed the land, that a study may be made of the persistency of the forms when growing, as nearly as possible, in a state of nature.

Whether a drifting back to one or the other, or both parents, will take place, or instead, a new hybrid species will come into existence, is one of those questions that is not answered by philosophy, but by the action of the surrounding influences, in combination with the internal forces upon a confused and interblended stream of life currents.

Plot II., Series III., was sown to salsify, the seed in alternate rows being from the plot where hybrids occurred the previous season, and natural mixing was to be expected. There were but few plants among all these suspects that proved to be hybrids, and these were invariably in the rows with the cultivated species. These hybrids, similar to those of 1900, were of two types, previously described, and were large in size and enormous bloomers. The seeds of these plants were sown in mid-summer for a second plot of seedling hybrids, and have made a good stand for passing the winter.

A large amount of artificial crossing was done with the rows of the two parent species, that the stock of the hybrid may be so far increased next year that the roots may be tested as to their merit as an article of food.*

Other Crossing.

Two species of Martynia have been grown the present season for the purpose of hybridizing. Several fruits were obtained between *Martynia Louisiana* Mill. and *M. lutea*, with the former as the mother plant; but the three fruits upon the latter parent were too young when the frosts came to give viable seeds. What this union of two quite different species may produce is a matter for the future, but possibly an acceptable pickle may result.

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*Some of the above facts were given by the writer in a paper before Section G, American Association for the Advancement of Science, at its meeting at Denver, Colo., in August.

Many attempts were made to cross the trumpet creeper (*Tecoma radicans* (L.) upon the Martynia, but without success. While closely related, and in many peculiarities the same, one is a hardy vine and the other a tender herb, a combination of which characteristics one is not likely to secure.

The breeding together of the ordinary field flax (*Linum usitatissimum L.*, and the ornamental species *L., grandiflorum L.* (?), has been attempted, and several full-sized seed vessels were secured upon the latter species; they all but one proved to be seedless. In this instance the two species are widely separated in this, that the blue flax of the field has all its sex organs alike; but in the scarlet species of the gardens there are two lengths of the female organs. Plants with sex organs thus developed are combined with difficulty with other species. It is said that plants of one form of pistils are sterile to their own form and need the pollen of the other form of flower for fecundation. If this is the case it only heightens one's desire to effect the cross, if it is a possible thing.

PLANT BREEDING AND IMPROVEMENT IN OUR EXPERIMENT STATIONS.

The following is an abstract of a paper read at New Haven, Conn., November 12th, 1900:*

A brief letter of inquiry was sent to each Experiment Station, and from the fifty stations now on the official list reports were received as follows: Alabama, Arizona, Arkansas, California, Colorado, Connecticut (New Haven and Storrs), Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Lousiana, Maine, Maryland, Massachusetts, Minnesota, Mississippi, Missouri, Nebraska, New Jersey, New Mexico, New York (Geneva), New York (Cornell), North Carolina, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Washington, Wisconsin, Wyoming.

The list of Experiment Station responses are taken up alphabetically, omiting those reporting no work in plant breeding and selection.

Alabama.—Bulletin 56, May, 1894, is upon "Crossing for the Purpose of Improving the Cotton Fibre;" Bulletin 71, April, 1896, is

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*The fourteenth annual convention of the Association of American Agricultural Colleges and Experiment Stations.

"Experiments with Foreign Cottons," and Bulletin 83, June, 1897, has for its title "Hybrids from American and Foreign Cottons." "The combination of the *Gossypium hirsutum* and *Gossypium mantimum* yields a cotton plant which produces fibre of the best grade in strength, maturity, twist, length, fineness and yield per acre." * * *

California.—"In answer, etc., * * * for our work in the origination of new varieties by crossing, etc., we can only confess to have done nothing, nor have we published anything on the subject. Mr. Burbank, Judge Logan and Mr. C. P. Taft, of Orange; Mrs. Shepherd, of Ventura, and others, have undertaken much in this line, as you know, and because of the activity of private propagators we have given very little attention to the subject."

Connecticut.—Mr. J. B. Olcott, of Connecticut, was at one time strongly advocating the improvement of lawns by a method of grass cuttings, thus producing a uniform turf of the same strain of grass.

Georgia.—"Some years ago we did a good deal of work in crossing varieties of cotton."

Illinois.—Bulletin No. 21 gives the results of Mr. McClure in the crossing of corn, and Bulletins Nos. 53 and 55 report the work of Professor Hipkins in selection with reference to the chemical composition of corn. Considerable work has been done upon inbreeding of corn. Three generations of inbreeding results in almost sterility, the first generation showing a degree of unproductiveness that would practically amount to the ruin of a crop. So pronounced is this result of even the first generation from inbreeding that we are led to wonder if this is not the practical cause of barren stalks, which in this country amount ofttimes to 20 per cent. of the crop.

The results of Mr. McClure's work are briefly summarized as follows: "In 1889 sixteen crosses in corn were produced; in 1890 one hundred and fifty-eight." Among other things the results indicated "that corn grown from crossing two distinct varieties will be larger than the average of the kinds crossed, or when the parents are nearly equal larger than either."

Indiana.—For many years we have grown with much care a variety of yellow dent corn, which is known as "Purdue yellow dent."

Iowa.—Bulletin 14, August, 1891, is upon "Breeding of the Orchard and Garden Fruits," in which notes upon seedling crosses of apples are recorded. Bulletin 22 (1893) contains a section upon "Rosa Hybrids," which were of the Russian type of *Rosa rugosa* as the pistillate parent with "General Jacqueminot," "American Beauty," and other standard roses, the hope being a double hardy rose for the prairie region. In Bulletin 32 (1896), Professors Budd and Hansen report upon "Some of Our Advances in Breeding Fruits and Shrubs," and figure new hybrid roses of great promise. Hybrid strawberries, grapes, plums, pears, apples, are also considered. In Bulletin 36 (1897), under "Hybrid roses, gooseberries and strawberries," Professor Budd shows still further advances, and an engraving of a heavily-fruited hybrid between a wild gooseberry of Manitoba and the "Champion."

Kansas—Professor Kellerman, assisted by Mr. Swingle, began the crossing of field corn at the Kansas Station in 1888. From the report for the next year, 1889, the following: "The effect of crossing could always be plainly seen the second year, whether visible the first year or not. The crosses * * * were generally of two types. (1) those in which the kernels were uniform, and (2) those in which they were variable." From Bulletin 17, December, 1890, it is gathered that "The product of the third year is generally true to the seed planted." Forty-nine crosses of 1890 were planted in 1891, and of the 33 harvested, 25 showed intermediate characteristics between the parents. The bulletin concludes with the following statement: "The characters secured by crossing can be retained."

Louisiana.—From Bulletin 26, February, 1894, it is gathered that three years earlier, "Some stalks of cane, partly white and partly purple, were selected from the field of Soniat Brothers' Tchoupitoulas plantation. They were called by them bastard canes. These stalks were planted as follows: First row, the entire stalk; second row, the white joints of each stalk; third row, the colored joints of each stalk. At the end of the season, four distinct canes, as far as color could direct us, were obtained." By selection, the varieties have become fixed, received names and "are different from any other in our collection."

Maine.—It is gathered from the reports of 1893, 1894 and 1896 that much work has been done in improving tomatoes, and particularly through a species hybrid between the ordinary form (*Lycopersicum esculentum* Miller) and the current tomato (*L. pimpinellifolium* Dunal), the latter bearing small fruits in racemes like currants. By blending these two species, the "Lorillard," a standard forcing variety, being used with the current, and selecting and furthermore uniting the hydrid with the "Lorillard" again, the fruit has been brought up to an acceptable market size and the quantity much increased.

Maryland.—Considerable work is in progress along breeding lines in both the Horticultural and Agricultural Divisions, but nothing has been printed.

Massachusetts.—They have hundreds of seedling strawberries, seedling raspberries, some of which show great merit, and seedling strawberries, some of which are of great promise. A lot of seedling plums not tested in California have been sent to them by Luther Burbank for trial and distribution, the entire stock being in their hands.

Michigan.—From the bulletins and reports it is gathered that a large amount of work is done at the central and sub-station upon the trial of varieties of fruit and vegetables and their improvement through selection. In the earlier days of the Agricultural College some crossing and hybridizing was accomplished, in tomatoes in particular, by Professor Bailey, before he went to Cornell University.

Minnesota.—Bulletin 62 has been received upon "Wheat Varieties Breeding, Cultivation." Professor Hay, the author, is one of the leading breeders of cereals on this continent, with a rival of significance along his line in Dr. Wm. Saunders, of the Experimental Farms, Ottawa, Canada. As early as 1889 Professor Hay published from the Minnesota Station, bulletin 7, upon "Improving Corn by Cross-fertilization and Selection," The following facts are taken from the summary of the bulletin recently issued : "Hybrids vary greatly in yield, in grade or quality, in rust resistance. * * * By systematic selection of * * * hybridized wheats, improved varieties are originated at slight cost. * * * Three out of thirty varieties, first originated by selection, are being disseminated, and seven new hybrids are very promising."

Mississippi.—Did considerable work in crossing some of the "Egyptian" varieties of cotton with our native sorts.

Missouri.—Here they have two varieties of seedling strawberries not yet named—promise to have much commercial value. They are also working on radishes and plums.

Nebraska.—The Professor of Horticulture kindly referred me to the thirteenth annual report, where it was found that "Work has begun in improving the sand cherry by selection, * * * by hybridization with cultivated plums and cherries. The wild plums are being treated in much the same way." The wild black raspberry and wild grape are being considered, and the hybridization of beans and of watermelons are going forward, while a co-operative experiment in corn breeding with Dr. Webber, Chief of Section of Plant Breeding of the United States Department of Agriculture, is well projected.

Aside from the work noted in the report referred to, by letter it is learned that this division has recently begun an important piece of work along the line of the production of new varieties of apples by means of hybridization.

New Jersey.—Some work is being done in the breeding of truck crops, particularly beans, eggplants, tomatoes and sweet corn. Nothing is yet ready for distribution. A hybrid has been secured between two species of salsify, that shows great vigor and may prove less liable to the white mould than the old garden form.

New Mexico.—"In the earlier part of the history of the Station an attempt was made of originating varieties of wheat by crossing. In 1898 cross-pollination was performed with the 'Wolf' and 'Yellow Egg' plums."

New York (Geneva).—"This Station has given more or less attention to plant improvement by crossing, etc., since 1883. About that time Prof. Godd originated the 'Station' pea, which is regularly listed by some seedsmen, and the 'Station' tomato. Since 1893 the work with strawberries has been continued till the present. Only one variety has been disseminated for trial, viz., the 'Hunn.' Particular study is given to the improvement of grapes and in fixing certain characters. This work is fundamental and preliminary to any marked advance in the improvement of this fruit. Some attention is paid to apples and pears, also gooseberries and currants. At the close of 1889 the inventory showed the following Station seedlings under test: Apples, 81; pears, 39; apricots, 5; cherry, 1; peach, 16; plum, 42; grape, 636; currants, 53; gooseberries, 680; black and dewberries, 182; raspberries, 958; strawberries, 429; total, 3,122. To this list were added, in 1900, apples, 65; pears, 35, and something over 3,000 grapes. A few were discarded, but the present number of Station seedlings under test is more than 6,000. Many hundreds in past years have been discarded.

"The one who, of all others, has been the leader in point of time and amount of work in the breeding of corn is the late lamented Dr. E. L. Sturtevant, who, as early as 1883, in the second report of the New York (Geneva) Experiment Station, recorded much study of, and tests made with, the crossing of corn. Each annual report for several years contained details of the hybrid corns, with observations upon the same."

New York (Cornell).—In the horticultural department they have made rather extensive studies, for many years, of plant-breeding, but for the purpose of arriving at the principles which underlie the subject rather than producing new varieties. Only one commercial variety have we sent out, and that is the "Ignotum" tomato, a rather full history of which you will find in the latter part of Bailey's "Survival of the Unlike," and also in "Plant-Breeding." They have produced at least one thousand varieties of pumpkins and squashes, none of which, however, were of sufficient commercial importance to be introduced. They have made great numbers of crosses with flowers, fruits and other things, but not for the purpose or originating varieties which could not be propagated and named. The original desire was to make varieties of fruits and vegetables, but it soon changed for the more important one of arriving at principles first, as there seems to be a lack of comprehension of this subject in the public mind.

North Carolina.—The principal success heretofore has been in the growing of a great variety of colors of the popular shrub, generally known as "Crape Myrtle." They are also working toward getting a tomato more resistant to the Southern bacterial blight, starting with the little cherry and plum sorts that are the most resistant. They have also a new eggplant, that seems resistant to this blight. In the way of garden vegetables they are at work trying to produce a lettuce that will suit the winter gardeners better than any they now have.

Oregon.—The work has been undertaken along the line of fruits and flowers only. They have a very promising pear, that was crossed several years ago with the "Winter Nelis" and "Bartlett." The tree has borne fruit this year, and has the qualities of the two parents. They have fifteen crosses of roses and a number of good crosses of the pelargonium.

Rhode Island.—In the horticultural department strawberries and beans have been experimented with. The selection of bush fruits is also underway here. The agricultural division is investigating the peculiar characteristics of the corn-plant, and will endeavor to determine, if possible, what characteristics of the stalk, leaves, etc., are correlated with the best yield of seed. An attempt is being made to establish a standard for the corn-plant, at least of two varieties, and to breed to it for improvement. Similar work is being carried on in studying the characteristics and seeking to improve the yields of several varieties of timothy, wheat and rye. An attempt is also being made to secure, by selection and breeding, strains of several varieties of soja beans and cow peas in the endeavor to secure plants which will be especially adapted to the soil and climatic conditions of Rhode Island.

South Carolina.—The only work in the lines mentioned has consisted in producing new varieties of cotton from artificial cross-breed-breeding and by hybridizing the *Gossypium Barbadense* and *G. herbarium.* In both lines they have succeeded in producing cotton superior to either parent.

South Dakota.—Several hundred crosses were effected this year, the work being outlined as follows: (*a*) Crossing of several Russian wheats on fife and blue stems; (*b*) selections from both the blue stems and the fifes; (*c*) the crossing of spelt and barley and spelt and hard wheat; (*d*) selections from spelts, oats, barley and corn; (*e*) the crossing of the two best varieties of field peas; (*f*) the crossing of our two most promising varieties of corn; (*g*) work has also been begun on clover, Turkestan alfalfa, about twenty species of grasses and the species of salt bush.

The lines of work in the Horticultural Department may be summarized as follows: 1. The breeding of native fruits by selection and crossing. 2. The breeding of apples and plums. 3. The breeding of an extra early smooth tomato by crossing and selection. 4. Hardy stocks for the orchard fruits. 5. Cultural and variety tests of vegetables and fruits. 6. Hardy hedge and ornamental plants. 7. Forestry and tree-plants.

Washington.—They have begun the improvements of wheat, both by crossing and by selection, and are attempting to produce winter wheats that will stand if on rich soil, will not shatter out with handling, have white grain, no beards, yield well, and resist bunt. In selecting, they are working with two distinct objects in view; the first is to improve standard varieties; the second is to determine the effect of continued selection in any given direction. For the latter, characters are chosen that easily show the effect of selection when there are effects, such as breeding beards upon bald wheat, and *vice versa;* breeding rufus chaff from white, etc.

Wisconsin.—They have been at work for several years past in seeking to improve the varieties of the native plum, the apple, the Missouri currant (*Ribes aureum*) and the dwarf Rocky Mountain cherry (*Prunus besseyii*). They have also commenced some work with wild black cherry (*Prunus serotina*). They are doing this work chiefly by growing seedlings. In the apple they have planted selected varieties in an isolated place, with the express intention of planting the seeds from all the fruits that grow on the trees. In the native plum they are planting seeds from trees that are located to favor cross-fertilization. In the wild black cherry they have started with the finest wild variety that they have been able to find, and hope to secure a fruit large enough to have commercial value.

In the above digest of the results of our Experiment Stations in plant-breeding it has not been the intention to include all the work done along the above line in the United States. Much has been accomplished by persons who were not associated with Experiment Stations and Agricultural Colleges, and, in fact. did their work even before these institutions came into existence. In this connection one first recalls the development of our American grapes and the infusion into them of the European blood, and call to mind the names of Bull, Rogers, Haskell, Ricketts and Moore, of the East, while Rommel, Jaeger and Munson have labored faithfully in the Southwest. These and others have already made America famous for its long list of varieties of superior cross-bred grapes.

Among pears we have blended the blood of the common with the Chinese species, and obtained varieties that have made pear-growing possible, if not very profitable, over a wide region where it was precarious before. The names of Keiffer and Leconte will be associated with these excellent results in hybridization.

The fact that the ordinary varieties of Eastern apples were not hardy in the great, cold Northwest, early led to importation from Russia, and the crossing of the common species with the Siberian Crab, the good results of which are still in store for the people of the twentieth century. For similar reasons the native plums in the West and South have been placed under culture and bred with the European types. Along with this is the advent of the Japanese plums and the formation of a group of hybrids, that places the name of Luther Burbank among the word's great horticultural benefactors.

Less distinct from the Experiment Stations than many of the plant-breeding enterprises included in the above general remarks is the work upon the citrus fruits by Messrs. Webber and Swingle, of the United States Department of Agriculture. The "Florida freeze," from which catastrophe the orange growers now date all passing events, aroused the government to the point of seeking for a more hardy orange, and the hybridizers are well on their way to produce it.

Space does not permit of more than a passing allusion to the hundreds of florists who are constantly keeping American floriculture in the van, particularly as to new crosses of carnations, chrysanthemums and roses.

For the last few remarks I am indebted, in part, to the excellent paper, "Hybridization in the United States," by Professor Bailey, in the recently-issued report of the Hybrid Conference, held at Cheswick and London, in July of last year, at which Professors Webber, Swingle and Hays took part, and besides, Professor Bailey, Dr. Macfarland and Mr. Thomas Meehan sent papers. In this world's conference upon a world-wide subject, the United States took its full share of honors.

It now remains for the Experiment Stations to follow up the work so well begun, and remember that he who improves the plants of a country improves its products and its people.

EXPERIMENTS WITH SALAD PLANTS.

Swiss Chard was grown in belts 4, 5 and 6, Plot IV., Series V., sown early (May 13th), while two belts elsewhere (Plot II., Series V.) were sown late (July 28th). Both sowings grew well and furnished an abundance of the leaf stalks. The early lot was somewhat affected with the leaf blight (*Cercospora beticola* Sacc.), while that sown late was nearly free. This verifies the results of former years, that the blight does not flourish upon the late-grown plants, and those who wish an abundance of a wholesome pod herb can obtain it from Swiss Chard when the seed is sown in ordinary soil as late as the 1st of August. Some plants that had been removed to the greenhouse in autumn, and after furnishing leaf stalks through the winter, were again taken to the field, where they made a fine early growth. This test shows that the Swiss Chard is easily handled, and when there is opportunity for continuing the growth indoors it can furnish acceptable greens during winter.

Some attempts were made to test this salad in the city market and with reasonable success. Nearly all who used it were desirous of getting more.

New Zealand Spinach.—A few plants of New Zealand spinach were taken from the greenhouse to the trial grounds in early spring; elsewhere seed was sown at the same time. The plants thrived and furnished throughout the hottest weather an abundance of tender leaves and tips of stems. While the plants from the greenhouse covered the ground rapidly, those from seeds were fully as large in September.

This is an excellent salad plant, that is worthy of attention by every one with a garden and a fondness for greens throughout the season.

Parsley.—Two varieties were grown in small quantity and both thrived and made fine plants. It transplants readily, and the field-grown plants may be treated as above mentioned for the chard.

EXPERIMENTS WITH WEEDS.

The piece of ground, 11 by 33 feet, called "the weed belt," has been continued for the fifth season. Plants have grown wild, ripened their seeds and scattered them as in a wild state. The following is the list of fourteen species most prominent during the year :

1. *Rumex acetosella* L. (0), (7), (4), (1).
2. *Bromus racemosus* L.
3. *Abutilon Abutilon* L. (7), (2), (6).
4. *Polygonum Pennsylvanicum* L. (6), (3), (2).
5. *Daucus Carota* L. (12), (0), (0), (4).
6. *Chrysanthemum Leucanthemum* L. (0), (0), (0), (9).
7. *Silene noctiflora* L. (9), (13), (14), (7).
8. *Taraxacum Taraxacum* L. (0), (0), (9), (5).
9. *Convolvulus arvensis* L.
10. *Melilotus alba* L. (0), (0), (0), (12).
11. *Oxalis stricta* L. (0), (0), (0), (8).
12. *Plantago lanceolata* L. (0), (0), (11), (10).
13. *Rudbeckia hirta* L.
14. *Ambrosia artemisæfolia* L. (3), (5), (1), (1).

It is seen that there are three new species upon the list, and of the eleven old ones many have changed places. A brome-grass, the field bindweed and yellow daisy are the ones that have come toward the front, while the ragweed, for example, has dropped from the head to the foot of the list. The smartweed, velvet leaf, wild carrot and catchfly are all near their places for 1900.

There are many competitors not in the above list, among which the following are mentioned :

Three kinds of clover—white, alsike and red ; five kinds of grasses—timothy, foxtail, redtop, a poa and a fescue ; dock, mercury, goose-foot, four asters, burdock, flea bane, salsify both cultivated and wild, broad plantain, asparagus, tomato, young grape vine and small cherry tree.

One of the things observed is the tendency for the ground to become covered with a growth of low plants, as the clovers and grasses and bindweed ; along with this there is a formation of a second layer of foliage, represented by the sweet clover, yellow daisy, velvet leaf and smartweed. Above this will be the cherry tree and the grape vine, providing the latter reaches the tree, as it is very likely to do in time.

EXPERIMENTS WITH LAWN GRASSES.

The nine plots of grass selected in the spring of 1896 have been kept closely cut with lawn mower during each season, and notes made from time to time upon the condition of each plot. The following table shows the species of seed sown in each plot and the condition of the stand of grass, in percentage, for the past six years :

	1896.	1897.	1898.	1899.	1900.	1901.
Plot 1. Meadow Fescue (*Festuca pratensis* Huds.)	90	50	40	45	55	60
" 2. Fine-leaved Fescue (*Festuca tenuifolia* Sib.)	5	50	40	40	40	45
" 3. Sheep's Fescue (*Festuca ovina* L.)	10	50	40	40	30	25
" 4. Rhode Island Bent (*Agrostis canina* L.)	80	80	90	90	90	95
" 5. Wood Meadow (*Poa nemoralis* L.)	60	65	70	85	80	85
" 6. Kentucky Blue (*Poa pratensis* L.)	50	65	90	90	85	85
" 7. Rough Meadow (*Poa trivalis* L.)	90	65	70	70	45	70
" 8. Redtop (*Agrostis alba vulgaris* With.)	100	90	70	60	25	25
" 9. Perennial Rye (*Lolium perenne* L.)	100	85	70	40	20	15

It is seen that the "Rhode Island Bent" holds up well, and the stand, this autumn, at time of last inspection, was approaching perfection. In the dry weeks of summer it becomes brown, and for this reason the present rating may be high. It is exceptionally fine in texture. The "Kentucky Blue Grass" has proved very satisfactory for the last three years, but some weeds have crept in the present season. In the "Wood Meadow" plot the grass has held its third place for three seasons. The "Meadow Fescue" has made a gain this dry season over the previous year, and, being at one end of the row of plots, is favored by a border gutter along one side of the plot. The "Redtop" shows a poor stand and the "Perennial Rye Grass" is nearly gone out. The leading weed in autumn is the crab grass, that fills in all vacancies.

EXPERIMENTS WITH ORNAMENTAL PLANTS.

The following ornamental plants were grown this year, several for the sixth successive season :

Chrysanthemum.—A type of hardy chrysanthemum has been grown in the Experiment Area for several years and uniformly free from the rust (*Puccinia Hieracii* Mart.), that has been so destructive to the greenhouse chrysanthemums. Last year it was stated in the annual report that Mr. Kelsey found the rust upon some plants in a florist's garden. The present season a plant of this affected sort was set in the midst of the chrysanthemums in our Experiment Area, with the result that the rust is now to be found upon the plants that for years have been free from the disease. That this is the same species of rust now so troublesome indoors is still a question, and as only one stage of the fungus is found its exact species is not determined. Last year some of the original plants were removed to a place nearly a mile away, and these remained free from the disease.

Pæonias.—The plants are gradually increasing in size. Hot, dry summer weather injures the foliage somewhat; otherwise they are fine.

Japanese Redbud.—Some of the trees have died, the winters being too severe for them. The foliage is too tender for our most trying summer weather. A cross with the native species is in mind, to overcome the weakness and yet preserve the good qualities of the dwarf tree, that blooms so handsomely in early spring.

Hibiscus.—Much thinning out of the plants was required this spring. Some of the crosses made previously were in bloom.

Cannas.—The row of cannas added a brilliant display to the ornamental portion of the Experiment Area. Several seedlings, some of special worth, came into bloom.

Nasturtiums.—Only the large form was grown this season, and, as before, showed the scorching of foliage mentioned in previous reports. Shading on the hottest days is a great advantage.

Mignonette.—Several forms of this were grown with a varying amount of the leaf spot.

Petunias.—A few plants of petunias were grown and gave a profusion of blooms throughout the season, with no showing of any sort of disease.

Verbenas.—In connection with a study of a mildew, two lots of verbenas were kept among the ornamental plants. They maintained their good name for abundant flowers during the autumn months.

EXPERIMENTS WITH PHLOXES AND THEIR ALLIES.

Belts 4, 5 and 6, of both Plots II. and III., of Series VI., were occupied with several kinds of plants, all of the natural family of Polemoniaceæ, of which the garden phlox is a prominent member. The following plan shows the arrangement of the plants, placed in rows running the short way of the belts; that is, the rows were eleven feet long.

HALF PLOT II.—*Phlox Drummondii* and *Cobæa*.

No.	Belt 4.	No.	Belt 5.	No.	Belt 6.
1	Chamois rose.	10	Kermesia.		Cobæa scandens blue.
2	Variabilis atropurpurea.	11	Rodowitzii.		“ macrostemma.
3	Atropurperea stricta.	12	Cuspidata.		“ scandens alba.
4	Coccinea.	13	Kermesia splendens.	19	Coccinea.
5	Leopoldi.	14	Occulta alba.	20	Black warrior.
6	Eclipse.	15	Alba.	21	Stellata splendins.
7	Rosea.	16	Mixed.	22	Mixed.
8	Half-dwarf bouquet.	17	Half-dwarf blood red.	23	Dwarf snow ball.
9	Dwarf surprise.	18	Fancy mixed.	24	Fire ball.

The cobæas interrupted the list of phloxes because desirable to place these rank-growing vines requiring a trellis, at one corner.

The phloxes failed in no instance to make a good stand, bloomed freely, and in general were probably true to the varietal names. Upon September 20th the following notes were made :

It is observed that as the plants get older there is tendency to vary from the normal form. The most conspicuous variation was the green (chlorotic) form, met with in nearly every row. These plants have the flower clusters with the bracts much prolonged and oval-shaped ; the corollas are with long tubes and the lobes not fully expanded, giving a half-opened appearance to the bloom.

A study of these greenish clusters show that many of them carry a small amount of the color, characteristic of the variety. Among the white sorts the green flowers are present, usually a whole plant being chlorotic when any part has green flowers. With red flowers, for example, the “green” plants bear flowers that are with the red only along the mid-rib of the corolla lobe ; that is, a single stripe. When there are flowers in a cluster, usually there are no two alike.

Aside from the tendency to produce green flowers, there was a variation seen in several plants. The usual change was shown in a loss of the normal color in one or more blooms, while others in the same cluster showed a deeper color than the ordinary. This was as if the color in the whole cluster had been unevenly distributed, and where one lacked another had an excess. Such clusters were marked especially for saving seed.

The phlox are particular favorites of certain butterflies, and among these insects the Papillios are the favorite attendants. The long tube of the corolla excludes all the smaller insects and those with short probosces.

The profusion of bloom upon these plants has been something astonishing, especially in view of the fact that no cuttings have been made, and seed was found all through the season. The constant supply of blooms in great variety of colors, varying through all shades from white to a dark red, the *Phlox Drummondii* must be accredited with a high rank. These plants could scarcely fail to give satisfaction when making a bed of solid color or as mixed or in ribbons, as taste or circumstances may dictate.

The star form (*cuspidata*) was grown in limited amount for purposes of crossing, and it proved wonderfully variable, for out of a dozen plants no two were alike in size, shape and color of the blooms. It is sufficiently peculiar as to merit a place in the breeding grounds, but the colors need fixing, and much may be done to improve this strain of phlox.

Half Plot III.—Various Polemoniaceæ.

In this area three genera of closely-related plants were brought together for purposes of study and breeding. The following is the arrangement of the species, the rows running across the belts as with the annuals given above :

Belt 4.	Belt 5.	Belt 6.
Gilia tricolor.	Gilia capitata (blue).	Gilia nivalis.
Gilia achillæfolia alba.	Gilia achillæfolia rosea.	Gilia laciniata.
Phlox subulata var alba.	Phlox maculata.	Gilia achillæfolia.
Phlox pilosa.	Phlox paniculata.	Polemonium grandiflorum.
Phlox divaricata.	Phlox Himalayense.	Polemonium cæruleumalbum.
Phlox subulata var frondosa.	Polemonium cæruleum.	Polemonium reptans.

As these are set for continuous tests in crossing, little need be said upon the group for the first season. The polemoniums are early bloomers, while the phloxes and gilias, especially some of the latter, are continuously in flower from early summer until the season closes.

EXPERIMENTS WITH SPRAYING.

The spraying with fungicides this season has been limited almost entirely to soda-bordeaux, with the same formula as in previous years, and it was used only upon a small portion of the crops grown.

Tomatoes.—The middle belt of "stock" tomatoes, Plot III., Series III., received four applications of soda-bordeaux on the following dates : July 20th, 29th ; August 8th and 27th.

The blight (*Septoria Lycopersica* Speg.) was the only form of disease observed this season, and as the plants were but lightly infested there was but little difference observed in favor of the sprayed belt.

Among the crossed tomatoes the leaf spot developed to a much greater extent, many plants being nearly defoliated before the end of the season. There was almost no fruit rot the present season.

Chard.—Belt 5 (2 rows), Plot IV., Series V., was sprayed four times with soda-bordeaux upon the following dates: July 20th, 29th; August 8th and 27th. Considerable leaf spot (*Cercospora beticola* Sacc.) had developed upon the sprayed rows by August 27th, but to a much less extent than upon the unsprayed. The foliage of all was badly cut up by hail early in July.

The tops of all plants were removed about September 1st, and the subsequent growth suffered much less from blight.

Esculus.—Several three year-old horse-chestnut trees, alternating with untreated ones, were sprayed with soda-bordeaux on June 17th, 15th; July 29th; August 8th and 27th. The contrast between the unsprayed and sprayed plants was very decided, the former being more or less defoliated before the end of the season. Like results were obtained in 1900.

Grapes.—The middle third of the arbor at the farm-house received five applications upon the following dates: June 8th, 17th, 28th; July 15th and 29th. Ordinary bordeaux was used for the first spraying, soda-bordeaux for the remainder. The mildew was practically absent from the entire arbor. The sprayed foliage was seriously burned by the fungicide.

Kerosene Emulsion.

One belt of cucumbers and one of chard were sprayed three times with kerosene emulsion of half the standard strength—that is one ounce of ivory soap, two pints of kerosene to eight gallons of water. There was no checking of the blights and the plants remained unharmed by the emulsion.

One-third of the verbenas in the ornamental grounds were sprayed with the same emulsion for the mildew upon August 1st, 8th and 27th. The conditions were highly favorable for the fungus during the first half of the month, and mildewed leaves were numerous at the beginning of the experiment. After two sprayings the treated plants were less affected than elsewhere and had a glossy appearance, apparently due to the emulsion. From the latter part of August to the end of the season the mildew developed but little upon any of the plants.

One side of a lilac bush was treated with the emulsion August 25th and September 10th, without seeming to check the development of the mildew. In this case the mildew was well developed upon the foliage, and the two applications did not materially change the appearance of the leaves.

Three places in a large piazza plant of Matrimony vine were sprayed twice each week with the emulsion, and it seemed to prevent the appearance of the mildew upon the younger leaves, and the fungous patches upon the old ones were darkened and ceased to form spores.

Soda-Bordeaux and Paris Green.

To determine whether Paris green may be safely used with soda-bordeaux, the combination was applied to the following plants: Potatoes, eggplants, squashes, cucumbers and beans.

Each of the above were treated three times, at intervals of ten days and without harmful results, although the Paris green was used at the rate of one pound to 100 gallons, a much higher percentage than is commonly employed.

THE ASPARAGUS RUST.

During the present season it was not convenient to carry on any experiments with the asparagus rust, and only observations in the field and reports from the various Experiment Stations throughout the United States are given. The rapidity with which this disease has spread has added to the importance of a record of its present range.

Without reproducing the replies to the letter of inquiry sent out in September, the following extracts will show something of the wide range of the rust and also some points as to its relative abundance with that of last year.

From New England, where the asparagus is widespread, but generally grown only in limited quantities, the reports show that there is less rust this season. For example, in Professor Jones' report for Vermont, it is stated that "there has been less of the asparagus rust in this State than there was two years or so ago."

For Massachusetts, Professor Stone writes: "The rust has been prominent here this season and there has been a slight tendency for it to spread. * * * My theory has been that drouth causes the plants to become weakened, and hence followed by an outbreak of the rust.''

From Delaware, Professor Chester sends the following: ''During the past two years it has not been as general and destructive as in the two preceding years, but all in all it is general throughout the State.''

Professor Norton reports from Maryland that in some places the rust is abundant.

Professor Buckhout writes from Pennsylvania that ''the asparagus rust is scarce this year—much less than before.'' From the South Atlantic States the replies are to the effect that the rust is not in evidence, but from Texas, Professor Price writes, ''I have found the rust in Texas for the first time this year. * * * The first part of the season here was normal and the latter very dry, and the disease is still spreading. Judging from its first appearance here this year it seems quite likely that it will prove serious in the State.''

For the Middle States the reports are favorable. Professor Selby, for Ohio, writes that ''there appears to be no spreading of the rust.'' From Michigan, Professor Wheeler sends word that ''the rust, so far as I can learn, is not on the increase.'' Professor Goff writes from Wisconsin that ''a single case of asparagus rust has been reported to me this season. * * * This is the first * * * to my knowledge of the disease in our State.'' From Indiana, Professor Arthur reports the rust as abundant as last season, and ''that the infection of this region in general came this year largely or wholly from spores blown from considerable distances.''

Professor Burrell reports for Illinois that ''the disease has been spreading, and is now known in at least a dozen plantations throughout the State. * * * This last year seems to have been a bad one for the development of the parasite. Some beds that were known to be infected have apparently not shown it at all or to a very slight extent. I am inclined to think that the very dry weather throughout July and August had something to do with this state of things.''

From Iowa, Professor Pammel writes that ''I think the rust is on the increase; at least in this vicinity, but I have not been in correspondence * * * with reference to its general distribution in the State.''

In Nebraska, Mr. John Sheldon has made a special study of the rust, and through Professor Bessey, of the Experiment Station, he reports as follows: ''From observations made near Lincoln and the reports that have come in, there seems to be much less asparagus rust than last year at this time. Much of the brush that grew in the early part of the season was badly rusted, but the continued dry and hot weather of the summer helped to check it on a few small patches that showed rust now. A few Æcidia showed on them early in the season, but not in sufficient number to bring about general infection."

To the northward in South Dakota, Professor Saunders reports: "I cannot find as it is spreading. * * * It was observed lately infecting a field near Yankton." In North Dakota, from Professor Bolley, it is learned that "the disease * * * did not make much headway upon the garden plot of asparagus until this last summer, when the attack was general and very destructive. The crop began to yellow early in August, and by the last week in August, when it should have been very green, it was strictly brown and dried up. * * * This season has been simply a good growing one, with a little excess of rain in the early part of July."

In matter of range, record is made of the rust having been observed in Wisconsin, and that it is now as far southwest as Texas, where it seems to be in a violent form. From the notes upon the rainfall in various States for the present year, it is not clear that there is a close relation between the weather and the amount of rust. It is likely only one of the controlling factors.

In our own State it is gathered from personal observation, conversation with asparagus growers visiting the Station and letters from other accurate observers, that the rust has not been as severe as last year. Why there is a decrease may not be easy to determine. The present season has been noted for its moisture and high temperature in summer. For example, the rainfall for the three summer months for this year were: June, 3.54; July, 5.87; August, 9.43, or a total of 18.84 inches (see table elsewhere), while last year the same months gave 3.08, 4.74 and 2.68 inches, respectively, or a total of 10.50 inches. It is seen that the summer rainfall this season was nearly double that of 1900. To show that the precipitation has been excessive, it is stated that the average rainfall for June, July and August for the last twelve years, including the present excessive one, is 13.56 inches. It is only suggested that in this increased amount of moisture there may have been a condition favoring a greater growth of the asparagus and a consequent increased power over the enemy. It is also possible that the rains may have served to wash the spores from the smooth stems before they had time to gain a foothold.

Another point of climatic difference this season, that distinguishes it from others, is the excessive heat of July, which was 3.4 degrees above that of the average of the past twelve years. As a rule, one month, as July or January, etc., varies but slightly from the others, and, therefore, a seemingly small increase or decrease in the total average temperature is a great deal, and marks the month in which it occurs as either hot or cold. How this increased heat may have affected the rust is not clear, but it possibly was advantageous to the asparagus plants, giving them greater vigor and consequent resistant power.

Again, it may be that the considerable decrease of the rust may have been due to the effect of the natural enemies, the darluca in particular, which has been working unknown to the aspargus growers generally, and its presence is a hopeful sign here among fungi, as with injurious insects when some other insect is its parasite.

Another reason for the decrease may be the introduction of the French stock and the larger acreage of the "Palmetto," both of which sorts are far less susceptible to the rust than the varieties that ten years ago were the standard sorts.

The record for the year is encouraging, for, while it shows that the range of the enemy is no less widespread, there are indications of its destructiveness being abated. If much of the decrease of the past season has been due to the peculiarities of the season, as further observations may establish, it would be important information upon the case in hand.

Asparagus Rust on the College Farm.

On October 18th an inspection was made of the four plots of asparagus, row by row, and not plant by plant, as formerly. The whole field showed much green, and was in a far superior condition to that of last year, and better than in 1897, when the first observations and records were made for this field. The first evident thing was the comparative absence of the rust from the "Palmetto" variety, and the three rows of this sort in each plot were easily selected from the others, because of the deep green color and a large size of the plants.

One other sort, "Argenteuil," of which there is but a single row, showed equal exemption, but this is of younger plants than the "Palmetto" and much smaller.

In order to make a more definite record, percentages are assigned to the amount of rust, as in former years. Upon the same basis as for other years, the "Palmetto" does not show more than 20 per cent. of the rust, and the same is true of the "Argenteuil." There seemed to be no observed difference among the other varieties, namely, "Mammoth," "Elmira," "Columbian," "Colossal," "Brunswick" and "Cross Bred," and for these the record is 50 per cent. of rustiness.

The same area gave 77 per cent. last year.

It was observed that the rust was much more abundant upon the west than on the east side of the plants, and it is suggested that the dew dried off quicker on the side toward the morning than the afternoon sun, and then the spores did not have as good an opportunity to infect the plants as upon the west side, when the moisture remained longer.

EXPERIMENTS WITH PEAR BLIGHT.

Owing to the change of management of the pear orchard, in which the experiments with pear blight were being carried on, the work is, of necessity, brought to a close, and here is given the results of the four preceding years.

The plan of the experiments is given below :

	CULTIVATED ROWS.				SODDED ROWS.		
	Barnyard manure.	Nothing.	Commerc'l fertilizers.	Unchanged.	Barnyard manure.	Nothing.	Commerc'l fertilizers.
Row 1 Winter (January) Pruning.	1	2	3	4	5	6	7
Row 2 Winter and Summer (January and July) Pruning.	8	9	10	11	12	13	14
Row 3 Summer (July) Pruning.	15	16	17	18	19	20	21
Row 4—Check	22	23	24	25	26	27	28
Row 5 Winter (January) Pruning.	29	30	31	32	33	34	35
Row 6 Winter and Summer (January and July) Pruning.	36	37	38	39	40	41	42
Row 7 Summer (July) Pruning.	43	44	45	46	47	48	49

Fig. 2.

Plan of the Pear Orchard Experiment; the numbers represent the trees.

The results for the first year were given in detail upon pages 378–383 of the Report for 1897. The blight had been severe over the whole Keiffer orchard, then twelve years from setting, and from it the block of 49 trees was selected for its uniformity in size of trees and amount of the disease.

It will be seen from the above scheme that in the rows running in one direction (up and down) all the trees in a given row receive the same soil treatment, while in the rows running at right angles to these the trees are pruned alike. Three rows are kept in sod and three rows under cultivation. The row lying between these two belts of three each was treated the same as the other portions of the orchard, which surrounded the experiment block upon all sides.

One row each of the sod (row 1) and the cultivated belts (row 5) received barnyard manure in duplicate amounts, namely, five tons per acre of a mixture of horse and cow manure well rotted. Two other rows (rows 3 and 7), similarly situated, received commercial fertilizer, consisting of equal parts of ground bone, acid phosphate and muriate of potash, and at the rate of 900 pounds per acre. Rows 2 and 6 received no manure or fertilizer and separated each of the above pairs of rows.

The orchard had been under cultivation, and the ground preparation consisted in seeding down, upon the 15th day of October, 1896, the land under the right-hand three rows of trees. A mixture of timothy and clover was used; the catch was fine and a rank growth covered the ground by the next July.

In the pruning experiments the rows were taken at right angles to the soil treatment above described, and consisted in only two points of difference, namely, in the times of the removal of the blighted twigs. The trees of the upper row were pruned only in January of each year; in the row next below, in both January and July, and in the third row only in July. The middle row of the seven received no pruning, and rows 5, 6 and 7 were a duplicate of rows 1, 2 and 3, respectively.

The first pruning was in January, 1897, and, following a season of unusual blight, was very severe—so much so that more than half of the tops of some of the trees were removed, many of the large limbs being entirely removed. Any branch showing the dead tips and blighted patches were cut below the latter.

In the July pruning only twigs showing the dead, leafless tips of last year's destruction, and the dead twigs with their blighted leaves attached and that had been killed the present season, were removed.

In the summer pruning the trees were not cut nearly so severely as in the winter, because the green foliage served as a guide, and not the blighted patches upon the branches. The average length of the summer prunings was not far from three feet, while that of the winter was perhaps three times as long.

The following table shows the amount of pruning each tree received in terms of branches for the four years :

79	16	10	14	29	12	13
27 Died.	33	43	9 Died.	62	10 Died.	50
44	25	85	82	58	116	18
....	....	....	Died.	....	....	Died.
4	4	....	18	7	1	....
5	6	17	25	34	54	98
11	32	34	39	.... Died.	143 Died.	89

Seven of the trees died during the four years and their places were reset with young specimens of the same variety.

The following table shows the total crop, tree by tree, for the four years, in terms, of baskets holding five-eighths of a bushel.

								Total.
1..........	46	41	24.5	15	26	14.5	25	197
2..........	5	42.5	35.5	00	29.5	34	28.5	175
3..........	47.5	39	31	37.5	38.25	40	31.5	264.75
4..........	35	52	37.5	27.25	39.50	40.5	16.26	288.50
5..........	42	45.5	37	32	33.75	32	33.5	255.75
6..........	33	30	36	44	34	47.5	35.25	256.75
7..........	50	42.25	38.5	39.5	00	31	40.5	241.75
Totals.......	258.5	292.25	240	195.25	201	244.5	200 5	

On account of the death of certain trees, seven in all, and a large percentage, it is difficult to derive any results from the four years of the test—a period all too short for experiments of this kind.

If the fruit from all trees that died during the four years is omitted, the average for each row is by years as follows :

	1897.	1898.	1899.	1900.	Average.
Row 1	4.9	2.64	10.5	10.1	7.04
" 2	4.8	3.30	15.4	12.2	8.92
" 3	5.0	6.03	15.9	10.7	9.47
" 4	4.4	6.00	14.7	14.0	9.77
" 5	4.8	5.25	15.1	12.0	9.29
" 6	3.8	4.60	14.7	14.0	9.27
" 7	4.9	5.54	18.5	13.6	10.63

Much of the largest yield was during the last two years. The averages do not show any remarkable variations in yield, excepting that row 1 is quite low and row 7 considerably above the others, the middle five being very near the same figure. The unpruned row (No. 4) was better than the average of the treated trees.

The following table is of the averages for the rows with soil treatment in common :

	Row 1.	Row 2.	Row 3.	Row 4.	Row 5.	Row 6.	Row 7.
1897	5.43	5.18	2.93	3.50	5.17	4.64	4.54
1898	5.83	5.57	4.93	4.37	4.50	4.35	4.18
1899	17.60	18.00	13.70	13.00	13.80	16.30	13.30
1900	13.70	14.40	10.90	13.60	10.00	11.60	11.50
Average	10.64	10.79	8.11	8.62	8.37	9.22	8.38

If the conclusion is to be drawn from the yield of crop, the averages show nothing striking for either the sod treatment or the cultivation of the soil. It is to be noted that the best yield in the cultivated area was unmanured, and the same is true for the portion in sod ; but the differences are so small that the individuality of the trees might account for the variation. With the cultivated land, barnyard manure gave better results than the commercial fertilizers, but in the sod land the two corresponding rows were the same. If anything is indicated, it is that the soil of this orchard was sufficiently rich for a full yield of Keiffer pears without additional fertilizing for at least the four years covered by the experiment.

ROOT PARASITES.

Early in the season Hon. E. T. Gill, of Burlington county, sent specimens of a weed that was found in considerable abundance in his clover field. It proved to be the clover broom-rape. This is a flowering plant that is closely related to the "Snap Dragon" of the garden, and the "Toad Flax," or "Butter and Eggs," a common weed of the fields. The plant in question has a strange habit of fastening upon the roots of the clover plant and robbing it. The broom-rape, in other words, is a parasite and shows its thieving method of getting its living by being devoid of the ordinary green so essential to plants that get their food out of the crude substance of the earth and air. The broom-rape consists, therefore, of a very limited root system, which is fastened to the roots of the clover, known as its host plant, from which a comparatively stout, pale, yellowish-brown stem arises for a foot to twenty inches, bearing numerous sharp-pointed brown scales for leaves, of no great service to the plant, and a spike of blossoms that are of good size, and in color a mixture of yellow and blue.

The photo-engraving (Plate VIII.) gives three of the broom-rape plants from which the earth has been washed, and showing the peculiar method of attachment to the clover roots. The one in the middle is the largest of the many sent by Mr. Gill, and shows how, by being attached to one of the side roots of the clover, the parasite may gain enough nourishment to make a large stem, shaped like an ox-whip, with the large end attached to the host and bearing numerous flowers throughout the whole length of the portion extending above ground. Clover that is thus attacked cannot make a satisfactory growth, and from the subterranean nature of the pest during its early growth, any remedy is not easily applied.

In the present case it seems as if the seed of the broom-rape came into the soil along with that of the clover, but as all of the supply of seed had been sown, there was no opportunity upon the part of the Experiment Station to make an examination. The seed of this broom-rape (*Orobanche minor* J. E. S.), as with all the others, is very small and could pass as "dust" with the clover seed, and therefore is neither easily detected nor knowingly removed. If one was suspicious of the presence of this enemy, the clover seed might be especially cleaned, and even soaked in water, to remove the small broom-rape seed.

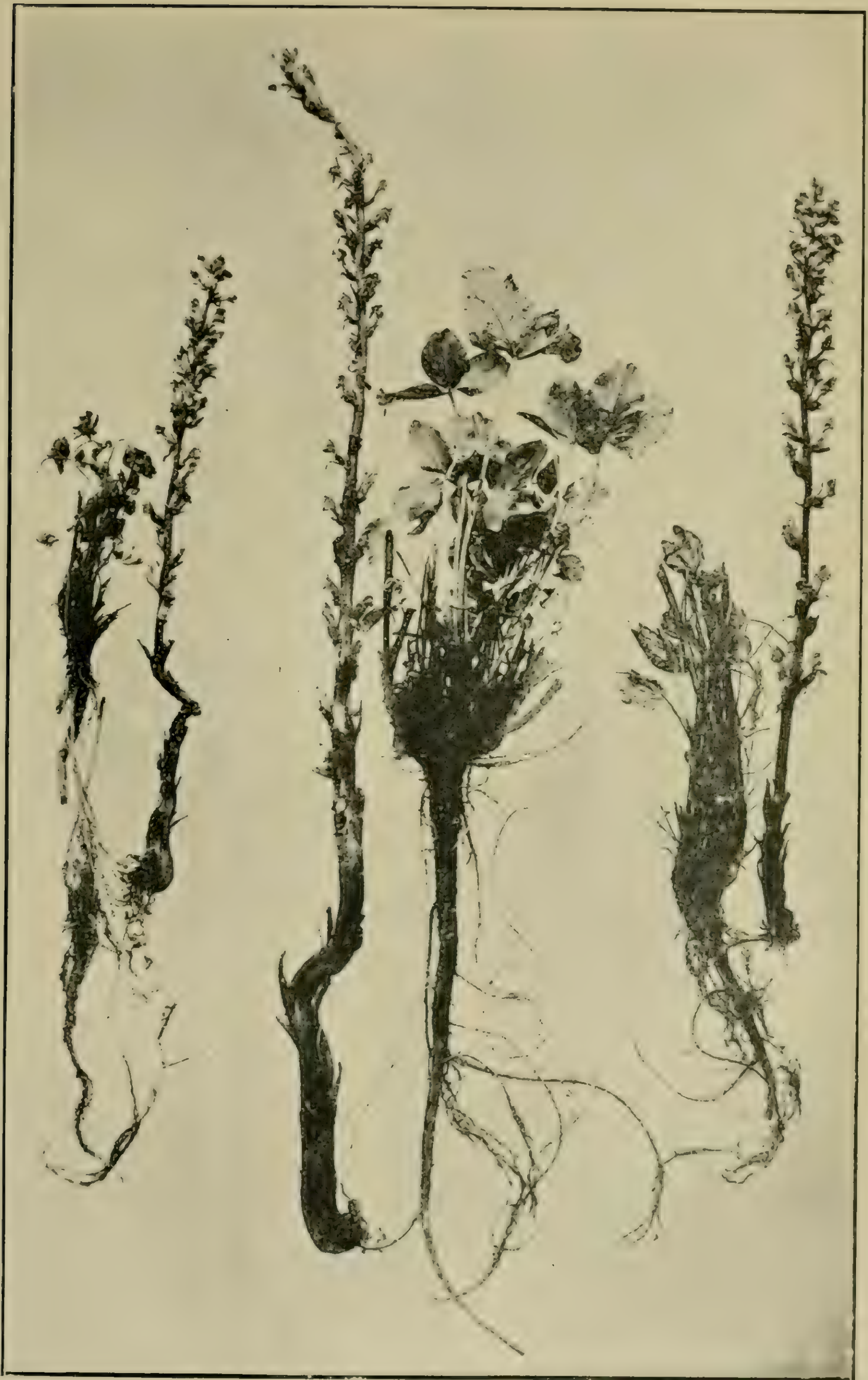

PLATE VIII.

Three broom-rape plants upon red clover roots.

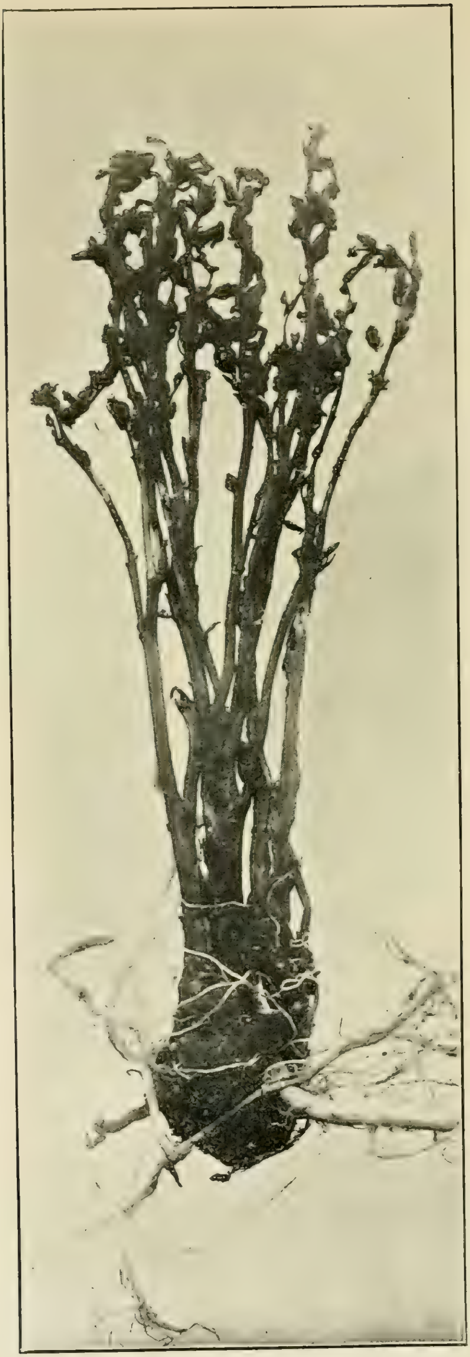

PLATE VIII.

Specimen of broom-rape upon tomato roots.

When the weed is found in the field it should be dug up and destroyed, and of course no clover seed saved from the infested area.

Fortunately, in this country, this parasite has not become generally troublesome, but in Europe, from which it came to us, it is more common.

H. Garman,* in his illustrated bulletin upon this subject, states that this plant has been in Kentucky for at least ten years. The parasite injures hemp and tobacco, in some cases to the extent of 50 per cent. of the crop. One observer states that he has seen it upon tomato. "Rotation of crops, burning over infested fields, care in collecting seeds for planting and the use of fertilizers to stimulate growth of crops," are suggested as methods of prevention of injury. "Gas-lime applied to the land in the fall has been found useful in destroying the broom-rape seeds."

In the Kentucky Station Report, 1896, Professor Garman states that the broom-rape was found upon the roots of cabbage, rape and shepherd's purse; but all attempts to cause it to establish itself on watermelon, clover, wheat and potatoes have failed.

Broom-Rape Upon Tomato.

During the past season a single tomato plant in the Experiment Grounds was infested with a broom-rape. This is a different species from that above considered, upon the clover, but of the same genus Orobanche, and is called *Orobanche ramosa* L., because of its habit of branching. The parasite fastened itself upon one of the several roots of the tomato plant and produced a base of considerable size below ground, from which a cluster of branching stems arose, bearing the many bluish-yellow flowers above ground in early July. The photo-engraving (Plate VIII.) shows the parasite after the soil had been carefully washed away; but the flowers had become withered before the picture was secured. The similarities between the parasite of the tomato and the clover may be seen from the plate, the chief apparent difference being in the one having a single stalk and the other a cluster compacted at the base.

It is interesting to note that the branched broom-rape is a common parasite upon the roots of hemp and tobacco, in Kentucky, where it is often a serious pest. The tomato belongs to the same family with the tobacco, and therefore, as these parasites go, it might be expected upon such nearly-related plants.

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* Bulletin 24, Kentucky Experiment Station, 1890.

Like the clover pest, this one is from Europe, where it is destructive, and tobacco and hemp culture is sometimes suspended for a time upon badly-infested areas, that the soil may become cleared of this root parasite.

ERGOT UPON GRASS.

Mr. A. M. Newman, Delaware, Warren county, made complaint, early in the season, of a growth upon the grass of a low meadow, which, upon the examination of specimens, proved to be an ergot. The grass in question is known as "Reed Canary Grass" (*Phalaris Arundinacea* L.), which produces a rank growth of fair herbage, surmounted by plumes six inches or more in length. In these heads the ergot appears as dark, hard masses, which look like enlarged grains, while in fact they are due to a fungus that takes possession of the grain when quite small, and, instead of an ordinary seed, a hard body is produced several times the size of the normal grain. See Plate IX.

A similar growth is met with upon the rye and many of the grains and grasses. When upon the rye it is often called "Spurred Rye," because of the hard grains, being, in size, shape and extreme hardness, somewhat like the spurs of a cock. These ergots are all peculiar in being very poisonous, and that upon the rye, when grown with the ordinary grains and eaten in bread, has often proved fatal to the human subject. This fungus growth produces a disease known as "ergotism," which is recognized by a loss of the use of the extremities. Thus, a person may lose a finger or a whole hand, by a sort of amputation, the circulation stopping and the part decaying away, leaving the stump of finger, arm or leg. When live-stock eat the ergoted grass in excess, the animals suffer in the same way from ergotism. Whole herds have perished in the West from this cause, as have entire villages of people in Europe, the latter largely because of a lack of care in separating the diseased grains from the others.

It is well for farmers to be aware of the nature of the outgrowths that may occur upon the heads of grains and grasses, and take any precautions necessary to avoid ergotism.

As the disease is confined to the heads, it follows that live-stock run no risks in ordinary pasturage until the grasses go to seed.

It is a fact that the ergoted grasses are more apt to be in the low land than where the soil is dry, and it is from the wild grass along streams that the most trouble is apt to arise.

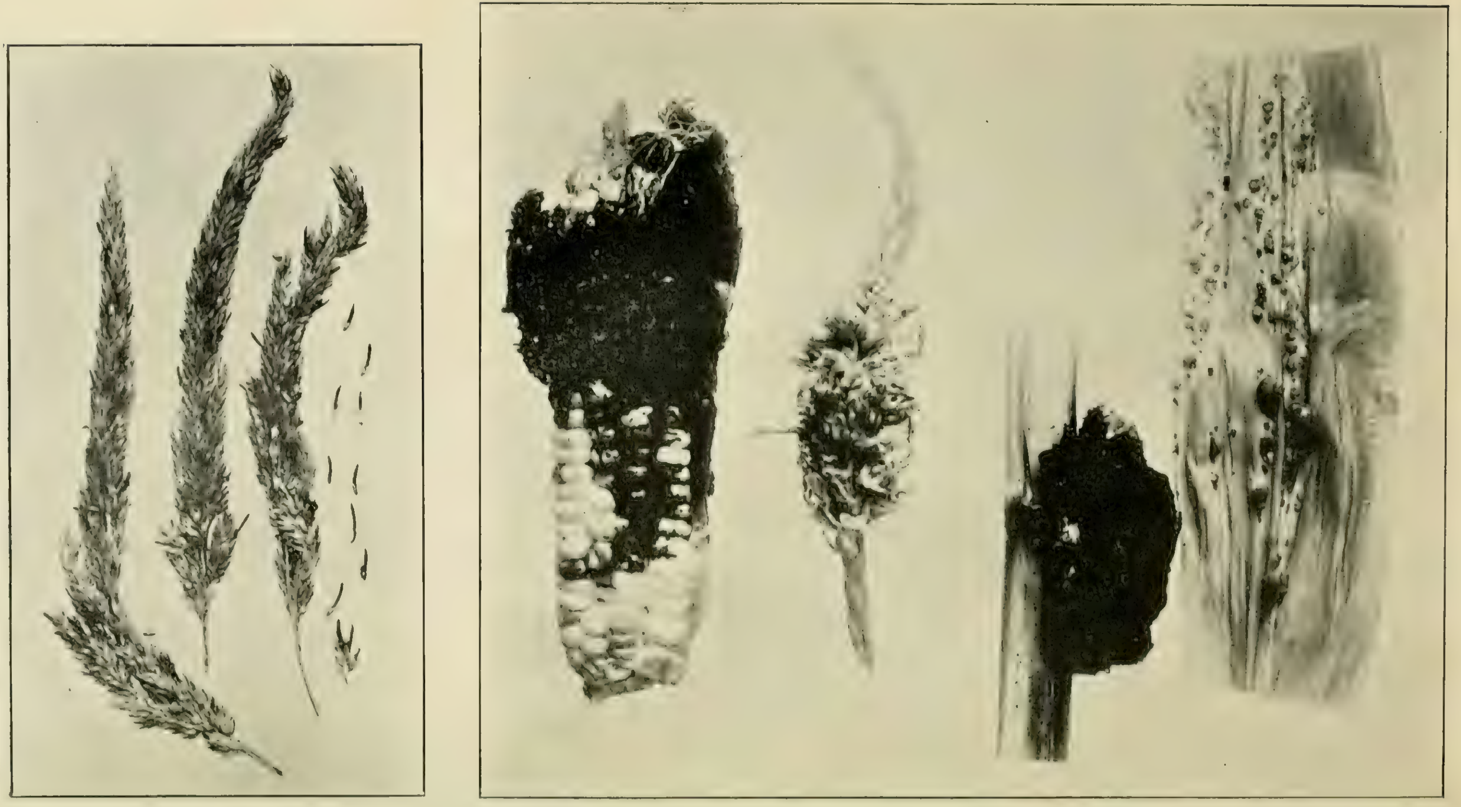

PLATE IX.

Upon the left, ergot upon the heads of reed canary grass, showing separated ergotted grains. Upon the right, cornsmut upon sweet corn ear, tassel, stalk and leaf, respectively.

NOTES UPON CORN SMUT.

The smut of corn was more than usually abundant the present season, and particularly so upon the early crop. In whole fields it was sometimes difficult to find a single tassel that did not show the smut, and often so badly that the whole top of the plant drooped because of the extra weight due to the smutted tassel. Soon after, the smut followed in the ear, and as the group of leaves out of which the ear grew was smutted, it seemed likely that the infection of the ear was from the tassel above.

The engraving (Plate IX.) shows an ear of sweet corn badly smutted at *a*, an infested tassel at *b*, a mature stage of the smut upon the stock at the joint at *c*, and the form often met with this year upon the foliage is shown at *d*.

THE BLIGHT OF CUCUMBERS.

There has been much complaint of blight upon melons, particularly the cantaloupes. An examination of the fields shows that the plants were in apparent good health until the middle of August, when the fruits were nearly full size. At that time the foliage became first spotted with yellow, soon turned brown and coiled up, leaving the fruit without any foliage to furnish them the sustenance desired, and they consequently became shriveled and worthless.

A microscopic examination of the leaves showed that the trouble was primarily due to the cucumber mildew (*Plasmopara Cubensis* B. & C.), which was favored in its growth and fatal developments by the conditions of the weather.

This mildew may be determined in a general way by the characters named above—that is, the yellow spots upon the upper surface of the leaf, followed by the brown color and coloring of the foliage.

There are other diseases of the melon tribe of plants, but none that behaves in this way. That there is a remedy at hand is beyond question, but the disease is so rapid in its growth that it needs to be used before any signs of the trouble are manifest. For example, during the present season a plot of cucumbers has been kept in full leaf and vigorous growth, upon the Experiment Area, by the use of soda-bordeaux, while a field of untreated muskmelons, not far away and no more susceptible, was entirely ruined by the first of September.

Several Experiment Stations have been seeking for remedies for the melon and cucumber mildew, and all find a satisfactory one in the spraying, provided it is done early, in anticipation of the enemy, that may come with great force when the conditions of warmth and moisture prevail.

THE MILDEW OF THE GRAPE.

Last year (1900) the mildew was very abundant upon the grapevine at the time that the plants were in bloom. Photographs were taken of canes, flower clusters and leaves, showing the mildew in great abundance. (See last Report, Plate X.) This year the same vines were watched closely and were sprayed with fungicide, in an attempt to check the growth of the mildew. But no mildew appeared upon the young clusters, canes or foliage until about the first of September, when the appearance of the young canes and leaves corresponded well with the same parts in the springtime of last year. No mildew was met with upon the clusters, which, at that time, were maturing the fruit.

It is remarkable that the results of the two years should be so different. This leads to a study of the conditions surrounding the plants for the two seasons. It is seen that the rainfall was somewhat unusual for the period under consideration, there being nearly nine and a half inches (9.43) for August to 4.23 for same month of the previous year. This does not, however, explain the non-appearance of the mildew in the spring, when the rainfall did not differ much for the two spring seasons.

TULIP MOULD.

A grower of Cape May county made complaint that his tulips were diseased, and, upon request, sent specimens for examination. The trouble was diagnosed as the Tulip Mould, which is due to a fungus, *Botrytis parasitica* Cav. Upon this subject Massee* states that "Cultivated tulips are often killed by a mould, which forms olive-brown, minutely, velvety patches on the stem, leaves and flowers. At a later stage, smooth, lentil-shaped sclerotia, at first grey, then black, appear, mostly in the outer parts of the bulb, sometimes being so numerous as to form black crusts. Preventive means: When the mould is observed the plant should be taken up and burned, to prevent the formation of the sclerotia, some of which are often formed in the soil, close to the bulb, and thus endanger subsequent crops." The trouble is figured by Cavara[*].

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* Plant Diseases, p. 158.

The botrytis in question is closely related to several others, and particularly the one causing a serious disease among lilies, investigated by Dr. Marshall Ward[†], in England, and by Mr. S. S. Kean, whose results were published, with colored plate, in the "Botanical Gazette" for January, 1890. "Professor Ward calls the lily disease one of the most annoying pests that the horticulturist has had to trouble him of late. The disease first shows itself as small, rusty spots upon the buds and leaves, and, by their enlarging in the blossoms, are ruined. This botrytis consists of coarse threads, which run in all directions through the attacked branched stalks, bearing multitudes of spores."

This form of mould is common upon many plants, and at times is very destructive to root crops, as turnip and carrot. The onion, another bulbous plant, is often attacked by the same or a similar gray mould (Botrytis). The multitudes of spores borne upon the tips of the branches germinate quickly, and, when lying upon the surface of a little leaf, will bore their tubes through the epidermis. When once inside, the thread increases in size and grows rapidly in length, branching and causing decay as it pushes along. After the Botrytis fungus has grown for a while it may produce dark, hard bodies, by a peculiar twisting and knotting of its threads. These dark masses, or sclerotia, remain uninjured through the winter, and when spring comes they produce peculiar, trumpet-shaped outgrowths, which finally give rise to multitudes of spores. These are set free, and, finding their way to the young lily, produce the destructive gray mould again. These spores, by their large numbers and quick growth, show how it is possible for the lily disease to spread rapidly. The Botrytis is fond of moisture, and, in a dry season, the lilies may be great. Mr. Kean suggests, as a remedy, "the planting of some other crop in alternate rows, which, with high and spreading foliage, will prevent the collection of the dew upon the leaves and thus check the fungus, so dependent upon moisture for its propagation."

A similar mould (*Botrytis galanthina* Berk.) is upon the "snowdrop," a plant closely related to tulip and lily. As this produces dark masses of sclerotia, it, like the others, may be classed in the genus Sclerotinia, as *S. galanthina* Lud. and other similar cases, so soon as the fruiting form associated with the sclerotids is determined.

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[*] In App. Pat. Veg. 10, Tab. VI., Figs. 1-4.

[†] Annals of Botany, Vol. II., pp. 319-382, 1888.

There is a form or species (*Sclerotina bulborum* Wak.) upon the onion. Others are upon the wind flower (*S. tuberosa* Fckl.), lettuce (*Botrytis vulgaris* Fr.), eggplant fruit (*B. fascicularis* Sacc.), and another is common upon carnation blooms.

The most common gray mould is *Botrytis cineria* Pers., associated with an ascoform, the *Sclerotinia Fuckeliana* DeBy. The former and older name was given to the more conspicuous stage of the fungus, which may be met with upon decaying vegetation quite generally. The second and "perfect form," as it is called, is less common, and, therefore, the confusion in the determination of a species, unless the perfect stage, is present with the mould form.

The tulip plants that were affected were set in the previous autumn, the bulbs being procured direct from Holland. The plants in the same bed where the mould appeared last year were the worst of all. Some specimens of *Lilium candidum*, growing near tulips, were apparently affected with the same trouble.

FUNGI AS RELATED TO WEATHER.

In temperature 1901 had a cold February, with a very hot July, that continued into August. There was an excess of rain in June and July, with an official record for August as follows: "The precipitation, the heaviest ever recorded during any August since the Service was established, came in the form of severe local thunderstorms. * * * The average (rainfall) for the month, 9.43 (inches), is 5.22 above the normal, and 6.75 above the average for the corresponding month of 1900."

The year has been one in which there has been very severe losses among the truck crops throughout the State; but perhaps nothing has suffered more than the muskmelon (citron, canteloupe). This crop has been ruined in some parts of the State, and this was largely due to the remarkable development and spread of a mildew (*Plasmopara cubensis* B. & C.)

This is a fungus quite closely related to the mildew of the grape, and in its need of moisture for its spread resembles the one causing the rot of potatoes. It is not unlikely that the unusual temperature and moisture at the time when the melons were growing most rapidly served to develop this enemy to the destruction of the forming fruits.

It is true that persons who lost their fields will have less chances of escaping the scourge next season, the conditions remaining the same, because of the stock of the germs of the disease that have accumulated the present year.

It may be possible, as with potatoes, to grow the crop so early as to escape the mildew, which does not come until the vines are well advanced. Some growers were able, this season, to get a portion of the crop, and by extra efforts towards earliness something more may be gained.

The matter of asparagus rust is treated elsewhere, and, in passing, it may be said that this is a fungus that necessarily must make its attacks late, and it is probable that the conditions of late summer and autumn have not been as favorable for the rust as for the past two seasons. It seems to be a fact that the asparagus beds were in much better condition in October than formerly, some of them being quite green.

The following items are gathered from the "Crop Bulletin," issued by the State Weather Service during the growing season :

April and May—"Heavy rains," "Soil full of water," "Potatoes rotting," "Anxiety concerning extent of rot," "Lima beans and sweet corn rotted badly."

June 4th—"Frequent heavy showers," "Much seed has rotted in the ground." June 11th—"Cherries rotting on the trees," "Corn yellow." June 18th—"High temperature," "Plums and strawberries have blighted," "Potato crop poor." June 25th—"Cool nights," "Fruit drops badly," "Considerable red rust in wheat," "Oats rusting."

July 2d—"Rain greatly needed," "Much rust," "Oats badly affected with rust," "Cherry trees blighted and crop ruined." July 9th—"Intensely hot weather," "Frequent showers," "Oats blasting," "Potatoes injured." July 16th—"Cool, cloudy and very humid weather," "Wheat and rye sprouting in sheaves," "Early potatoes almost a failure." July 23d—"Showers almost daily." "Grain damaged from sprouting." "Apples, plums and peaches are still dropping from the trees," "Appearances of blight" (potatoes). July 31st—"Plums and grapes rotting."

August 6th—"Weather normal," "Tomatoes poor." August 13th—"Heavy rains," "Melons late," "Canteloupes * * * badly infested," "Tomatoes dropping off." August 20th—"Tomatoes set light," "Plums rotting," "Peaches forcing," "Canteloupes very poor." August 27th—"Warm, foggy weather," "Peaches, potatoes, tomatoes and grapes rotting."

The following table shows the temperature in degrees (F.) and rainfall in inches for the present year, and the average for the past twelve years.

Month.	Temperature. 1901.	Temperature. Average 12 years.	Rainfall. 1901.	Rainfall. Average 12 years.
January	30.4	31.4	3.66	3.87
February	25.4	30.9	4.50	4.07
March	39.2	38.7	3.89	4.18
April	48.3	50.0	3.42	3.32
May	58.6	60.7	4.50	4.44
June	70.0	70.1	3.54	3.29
July	77.3	73.9	5.87	5.61
August	73.8	72.6	9.43	4.66
September	66.8	66.1	3.38	3.21
October	54.4	53.9	1.93	3.56
November	.....	.....	.....	.....
December	.....	.....	.....	.....

THE NEW GREENHOUSE.

The Botanical Department is now provided with a plant-house located near to the Experiment Station building, and therefore close to the laboratory and herbarium. It consists of a glass-house, 20 by 68 feet, and a head-house, 12 by 24 feet. The main entrance is level with the earth, and from the large vestibule the boiler-room is reached by a few steps. Above the heater and coal-bin is a general work-room.

From the vestibule the door leads directly into the plant-house, which is divided crosswise, near the middle, into two rooms, piped independently, so that the hot water may give different amounts of heat as required. The general appearance of the whole house may be obtained from the upper engraving in Plate X.

SEEDLESS TOMATOES.

Dr. E. L. Sturtevant, in his excellent paper upon "Seedless Fruits,"* mentions no less than sixty species of plants the fruits of which have been known to be seedless, either occasionally or as a regular thing, Under "Tomato" his statements are very brief, and omitting the table, are as follows: "It is a matter of common observation that the finest quality of tomato fruit contains fewer seeds than do those of inferior varieties. Burr also says there is a seedless

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* "Memoirs of the Torrey Botanical Club," vol. I., No. 4, pp. 141-188, 1890.

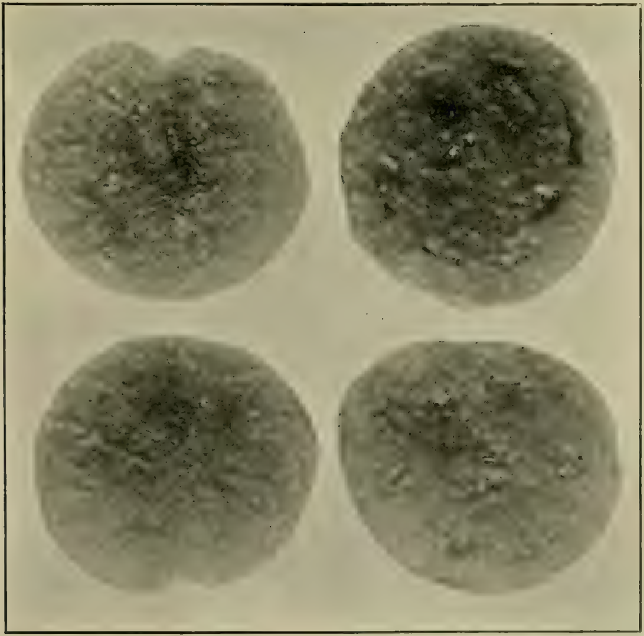

PLATE X.

Upper—Plant House of the Botanical Department (cut from True Bull. 93 U. S. Dept. of Agriculture)
Below—Seedless tomatoes in section as grown under glass.

variety, smooth and handsome, with few seeds.'' It is found that Burr, above referred to, in his book,* now approaching old age, but full of valuable information, adds but little to Dr. Sturtevant's statement when it says, under ''Seedless Tomato,'' ''Very similar to, if not identical with, 'Perfected Fruit,' almost rose-red, solid and with comparatively few seeds.'' The ''Perfected,'' including the so-called ''Seedless,'' it is stated, is an ''improved sub-variety obtained from the Common Large Red by cultivation and selection.'' To further quote: ''From the time of the introduction of the tomato into general use in this country, the Large Red was almost the only kind cultivated or even commonly known.''

These notes show that what was called the ''Seedless Tomato'' was only so in name; that it came upon the horticultural horizon before the development of the ''Trophy'' and its class, and it was a cultural form of the old, original red tomato, and is now lost from sight. A second fact of special value is Dr. Sturtevant's opinion as to the comparatively high quality of seedless tomatoes and the quickly-following inference that the reduction of the seeds would be at the gain of value to the fruit.

With this as an introductory, it may be of interest to state that absolutely seedless tomatoes have been produced at the New Jersey Experiment Station, and the following is a record of how the desired and possibly quite novel fruit was obtained:

In the breeding of tomatoes, that has been going on for some years, only two varieties have been employed, namely, the ''Dwarf Champion,'' representing the stiff-stemmed, upright type, sometimes called the ''Tree'' tomatoes, and the ''Golden Sunrise,'' which is a low-spreading, large, rapid-growing variety, practically the opposite of the first mentioned. The ''Champion'' bears a medium-sized, red fruit, and the ''Sunrise'' has a large, golden-yellow berry. These two sorts prove to be sufficiently distinct for the breaking up of their types when brought together in the process of crossing. As a result, there are many offsprings, that combine closely some of the characteristics of the parents, while others are left unchanged. This is observed in the stems and foliage, and perhaps more noticeably in the fruit, which may be mottled with the red and yellow. One of the ends sought, and being reached, is a fruit with a blush like a ''Crawford'' peach, at the same time being of high quality and borne by vigorous and prolific plants.

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* ''The Field and Garden Vegetables of America,'' Fearing Burr, Jr., 1865.

Last year there were two plants (Nos. 67, 177) which showed a most remarkable vigor, overreaching the ordinary plants from the same mother fruit surrounding them. These "Giants," as they were called, both resulted from crosses of "Champion" upon "Sunrise," and their fruits were red, like the pollen-plant, while in vigor of vine they exceeded that of the seed parent. Number 67 produced eighty-three fruits, all of them uniformly of small size, averaging an inch and a quarter in diameter, with the seed cavities, four to six in number, filled with a pulp but bearing only a few seeds—a half dozen or less.

The second very exceptional plant (No. 177), the greatest in size of all, bore only twenty fruits, red, like those of No. 67, but somewhat smaller and with the seed almost entirely absent from them all. In these the seed cavities were nearly obliterated, and the fruit became a nearly even mass of flesh, firm in texture and of superior quality.

Toward the close of the season the stems of both the above plants were layered, and cuttings were also taken, and thereby many plants were obtained that, taken into the greenhouse, bloomed and fruited during the winter. Several of these fruits were entirely solid, and any provision for seed production had disappeared. Fruits of this character are shown in the lower half of Plate X.

There is still much to be done to increase the size of the fruits, which, if accomplished by breeding with normal plants, may neutralize all that has been gained in the way of seedless fruits. The aim is to reduce the seed production to a minimum and not overcome it entirely; in short, to have a fruit of good size, with a rich, solid flesh, in which may be only enough of seeds to preserve the present way of propagation instead of requiring the gardener and trucker to resort to non-seed methods, as is necessary with the modern pineapple, banana, navel orange and the still later seedless lemon.

It may not be foreign to the subject in hand to state that the seedlings from these giant plants proved to be a very variable lot, with no two alike. Some were malformed dwarfs, that produced but a a single cotyledon, no plumule, and failed to grow, while others were misshapen in stem and leaf. Some were of the "Champion" type, others resembled the "Sunrise." Between the lines, the student of the problems of evolution may read some things that, while not conclusive, are certainly suggestive. The red and yellow types, chosen for the breeding, were widely enough separated to throw some of the crosses from the track and upset the ordinary prolific methods of propagation by seed. Out of the wreck—to continue the figure—it is hoped to rescue by careful combination a form that, in time, may be able to maintain itself with profit to mankind.*

A STUDY OF DIMORPHISM IN BUCKWHEAT.

Buckwheat is one of the cultivated plants that has its flowers dimorphic—that is, with two lengths to the stamens and two to the pistils. One plant, for example, has the pistil with long styles and short stamens, and another with the three styles of the pistil short and the stamens long. The plan in this is for the insect visitants to carry the pollen of the long stamens of one flower and deposit it upon the tips of the long styles of another flower, and the pollen of short stamens to the stigmas of short-styled pistils. This is done without any plan or intention on the part of the insect, for a certain portion of its body will come against the long stamen and the long style, while another portion touches the shorter stamen and the corresponding pistil. This dimorphic type of blossom is generally understood to be for the purpose of wide fertilization—that is, the impregnation of one germ-cell with the male-cell produced by another flower.

Assuming this view of the case, the point of the experiment was to determine whether any condition of growth or previous parentage had any influence in determining the particular form that the flowers of any individual plant assumed.

Seeds for the greenhouse experiments were saved from long-styled and from short-styled plants, selected from a plot grown in the field the previous summer. The first sowing was made in boxes one by two feet square and six inches deep, on October 24th, according to the following schedule :

Box I. Seed from long-styled plants, sown in poor soil.
Box II. Seed from short-styled plants, sown in poor soil.
Box III. Seed from long-styled plants, sown in medium soil.
Box IV. Seed from short-styled plants, sown in medium soil.
Box V. Seed mixed, but from plants grown upon heavily-manured soil.
Box VI. Seed mixed, but from plants grown upon poor soil.

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*A paper upon this general subject of "Experiments with Tomatoes," given by the writer before the Denver meeting of the Society for the Promotion of Agricultural Science, in August, contained some of the above facts

The flowers were counted upon November 27th, with the following results:

	Long-styled.	Short-styled.
Box I	20	12
Box II	11	25
Box III	11	17
Box IV	22	20
Box V	25	18
Box VI	14	21
Totals	98	113

The short-styled form was more numerous as a whole, but less so in three boxes, namely, Nos. 1, 4 and 5. The first four boxes are comparable, and here it is seen that the two boxes with "long-styled seed" gave 31 long-styled plants and 29 short-styled plants, while the two boxes with "short-styled seed" produced 33 long-styled plants and 45 short-styled plants. In each instance the form of the flower in the mother plant was in excess of the other type.

The poor soil gave 31 long-styled and 37 short-styled plants, while the medium soil produced 33 long-styled or 37 short-styled plants, or there is no evidence in this case of any influence on the part of the soil.

Boxes 5 and 6 show that the long-styled plants are more numerous when the mother plant has grown upon very rich soil and much fewer when the mother plants were upon poor soil.

On February 1st a duplicate of the above set was counted, with the following results:

	Long-styled.	Short-styled.
Box I	9	16
Box II	12	11
Box III	12	10
Box IV	13	14
Box V	11	5
Box VI	11	8
Totals	68	64

Here the totals are nearly the same. The two boxes with "long-styled seed" gave 21 long-styled plants and 26 short-styled plants, while the two boxes with "short-styled seed" produced 25 long-styled plants and 25 short-styled plants. Here the form of the flower in the mother plant was not that of the majority in the offspring.

The poor soil gave 21 long-styled plants and 26 short-styled plants, while the medium soil produced 25 long-styled plants and 24 short-styled plants. Again, there is no evidence of any soil influence upon dimorphism. Boxes 5 and 6 show an excess of long-styled plants, and greatest when the mother plant had grown upon very rich soil—a result that agrees with the duplicate boxes in the first series.

On January 11th a duplicate of the previous two sets was made, so far as the seeds employed is concerned, but the soil used was the same in all boxes and was three-fourths clean sand to one-fourth of fine soil, and therefore the nourishment was scant. The plants were small, and the following is the result :

	Long-styled.	Short-styled.
Box I	11	23
Box II	11	11
Box III	20	20
Box IV	13	10
Box V	14	9
Box IV	17	11
Totals	86	84

The totals are nearly the same. The two boxes with "long-styled seed" gave 31 long-styled plants and 43 short-styled plants, while the two boxes with "short-styled seed" produced 25 long-styled plants and 21 short-styled plants. Here the form of the flower in the mother plant does not show any positive influence upon the offspring. Boxes 5 and 6 have a large excess of long-styled plants, the greatest being when the parent seed was grown upon poor soil.

By combining the three above sets the following results are obtained :

	Long-styled.				Short-styled.			
Box I	11	9	11 =	40	12	16	23 =	51
Box II	11	12	11 =	34	25	11	11 =	47
Box III	11	12	20 =	43	17	10	20 =	47
Box IV	22	13	13 =	48	20	14	10 =	44
Box V	20	11	14 =	45	18	5	9 =	32
Box VI	14	11	17 =	42	21	8	11 =	40
Totals	98	68	86 =	252	113	64	84 =	261

It is seen that the totals for the two forms are practically the same. The "long-styled seed" gave 83 long-styled and 98 short-styled plants, while the "short-styled seed" produced 82 long-styled and 91 short-styled plants—that is, both forms of mother plants produced an excess of the short-styled form.

With mixed seed—that is, without regard to form of parent—that from very rich soil gave 31 long-styled and 23 short-styled plants, while the poor soil produced 25 long-styled and 29 short-styled plants. So far as these two tests go there is evidence that high manuring produces an excess of the long-styled, and poor soil an excess of the short-styled, form.

But plants from the same lots of mixed seed grown in sand gave quite different results—that is, the greatest excess of the long-styled form was from seed grown in ordinary soil and sown in nearly pure sand.

In the experiments in growing the third generation from the long-styled and short-styled seed, the results ran as follows :

	Long-styled.	Short-styled.
Long-styled seed	12	11
Short-styled seed	9	13

This indicates that there may be a tendency for the mother form to exert some control over the form in the offspring. If this is a fact it might be possible, by constant selection, to do away with one or the other form.

SPRAYING EXPERIMENTS IN GREENHOUSE.

Only a limited amount of spraying was done other than for the destruction of insect enemies. However, a test was made to check the powdery mildew upon some of the ornamental plants, in particular the phlox, verbena and roses. The broad-leaved plantain (*Plantago Rugelii*), grown in the greenhouse for another purpose, proved to be a fine subject for this work, first, because the plants are very susceptible to the mildew*, and secondly, the leaves are large, well disposed for treatment and quite lasting.

The sprayings were made with a small apparatus, that produced a fine mist, and the plants were treated once in ten days. Several substances were used, but, as florists object to any discoloration, clear liquids were chiefly employed.

One of the mixtures used is the kerosene emulsion, made according to the following formula : Kerosene, two pints ; ivory soap, one ounce, and water, eight gallons.

Upon the pholx, verbena and plantain this soon began to show

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* The species upon the phlox, verbena and plantain, growing close together, was probably *Erysiphe cichoracearum* D C., and of the roses, *Spharotheca humuli* D C., but as it did not fruit the determination is not made, and is not essential to the results of the experiment.

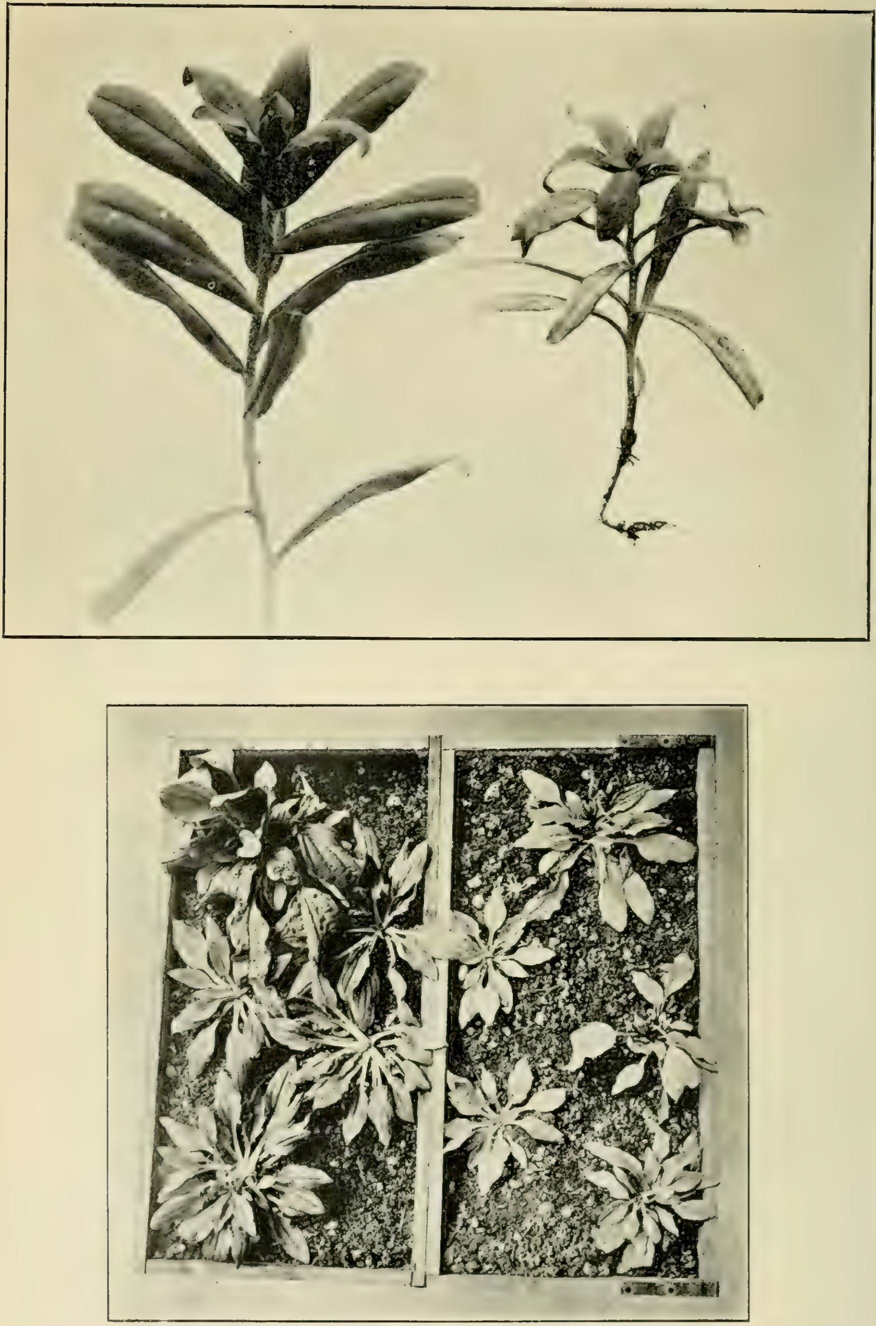

PLATE XI.

Mildew Experiments. Upper—On the left, sprayed Phlox plant; on the right, unsprayed plant. Lower—On the left, sprayed plantain; on the right, unsprayed plants.

desired results, and as the winter progressed it was evident that the emulsion was able to hold the mildew almost completely in check. Plants that were not sprayed became in all instances badly mildewed and dwarfed, while the treated ones kept nearly free of the fungus and showed a satisfactory growth in all parts.

Plate XI. illustrates the work in spraying. In the upper left-hand portion is shown a sprayed phlox plant, and on the right, one of the same age, untreated. The left-hand box shows five sprayed plantain plants, with a similar untreated box at the right.

ALBINISM IN SWEET CORN.

Albinism is occasionally met with in animals, as white mice, white crows and white blackbirds. In plants it is often partial and rarely complete, for in plants it is physiologically different from in animals, as, in its completeness, it is suicidal. The Century Dictionary defines albinism in plants as "A condition of flowers or leaves in which they are white instead of having their ordinary colors, owing to a persistent deficiency of the usual coloring matter, to be distinguished from blanching or etiolation where the color returns on exposure to light." Jackson, in his recent "Glossary of Botanic Terms," states, "Albinism, a disease from absence of normal coloring." In corn, albinos are perhaps the least rare; and many recall seeing white seedlings in the field.

The specimens that have been under consideration were met with in sweet corn that resulted from a cross between the "Black Mexican" and "Egyptian" varieties, and in the progeny of the second year of experimentation. The 1900 crop was grown from pink grains that were all from a single ear of the "Egyptian." (See Report for 1900, pages 439–444.) The one-twentieth acre was so situated that it had no opportunity for pollination from any other corn, save a few stalks of the same variety, ninety yards away. It was an inbreeding in a mild way. All of the ears of corn upon the plot in question were practically alike, in being thoroughly mixed and nearly equally between the white and pink or purple grains. In the tests for vitality of this corn the albinos became a prominent factor, and, in round numbers, one seedling in ten has proved to be white.

The crossed corn has been tested in several ways, with the thought of determining whether the tendency to albinism is inherent in the grains, or may be developed during germination. First, it was determined that the position upon the cob had nothing to do with this phenomenon. The much-compressed and misshapen butt-grains are no more apt to produce white plants than those from the middle of the row; neither are the small tip grains so disposed. Both extremities of the cob produce inferior grains, which quickly lag behind in the race of life, and are, for that reason, unfit for seed.

The grains were mutilated with the knife by cutting away a half, or less, of the endosperm just after they had become softened, or before in some instances; and while such grains germinated more quickly, probably due to the more ready access of water, they made a less vigorous growth than uncut grains and showed no increased percentage of albinos.

As the lack of green is evident from the first, there seemed little use of testing different media for germination; but tests have been made between blotting-paper in pure sand and in potting soil; but none of these exerted any apparent influence upon albinism.

The best-matured grains from well-developed ears were placed in contrast with small grains of less perfect ears, and here there was a marked difference, the poorly-formed, starved or immature grains being more apt to produce the albinos. In one such instance a small ear, but with the individual grains of fair size and good appearance, produced as high as fifteen albinos out of the one hundred grains taken consecutively from three of the rows.

The grains were germinated with various media, in a dark chamber, with the same results as previously determined in the light. The albinos were easily selected from the time they were two inches high, because of the same pale color as when grown in the light, which was easily distinguished from the straw-color of the seedlings, that in the light would have been green. In several instances, when the pan of seedlings from the dark chamber was brought into diffused light, the straw-yellow plants quickly became green, and, of course, the albinos did not change their color.

Other methods of torture have been indulged in, as that of adding uncongenial liquids to the seeds, either in sand, soil or the blotting-paper; but none of these have resulted in changing the percentage of the albinos.

Excess of temperature has been applied. Thus, soaked grains have been placed in water on the window-sill, over night, and the ice thawed out quickly, and the freezing repeated the next night, while a corresponding lot of grains from the same ear was placed in warm, moist soil, that offered the best conditions for growth. Here, again, the distress did not force any of the seeds to develop into the albino form, or, at least, the percentage of white seedlings was not increased.

Aside from the color, there is very little difference between the albinos and the normals when grown in the dark. They all are very long between joints, and soon fall to the ground. In vigor of growth, and in all other respects excepting color, there seems to be no difference between the albinos and the normal plants. In the light it is not so easy to come to this conclusion, for a young corn-plant soon puts on its working green color and begins the process of synthesis ; but, from a large number of observations, it may be said, in general, that up to the end of two weeks there is very little difference in the size of the white and green plants from the same ear. After that time the green plants rapidly take the lead, and the lagging albinos have ceased growing at the end of four weeks. These white plants offer an opportunity for the study of several problems in plant nutrition, in connection with the seed and its accumulated substance.

It would seem that the treatment of the seed during germination has no effect to produce albinos.

A test of thousands of grains of many kinds of corn have resulted in no albinos, excepting in one lot of 1,000 grains of a pop-corn, remarkable for its rapid germination and vigor when one true albino appeared.

Tests have been made with the yellow grains on white ears and the yellow grains of yellow ears of field corn, and the same way with pop-corn, but as yet the albino has not appeared among them.

The cause may lie in the crossing that had been produced in 1899, namely, between two very distinct varieties ; one an eight-rowed, black sort, and the other a ten twelve-rowed, white variety. Ears were then produced having a goodly number of the dark-purple or pink grains. It was these colored grains that were selected for the planting from which the albinos have been obtained.

No albinos are found in tests of the parent stock of "Black Mexican" and "Egyptian."

A STUDY OF DODDERS.

During the past winter the new greenhouse offered an opportunity for a study of that group of pestiferous plants known as the dodders, several of which are particularly destructive to crops, as that upon the clover, flax and allied plants.

The seeds of the dodder are not far from the size of those of red clover, and might be mistaken for alfalfa seed or even that of timothy. To show the relative size of the seeds of different species of dodder and some of the commercial seeds among which the dodder is carried as foul stuff, the engraving (Plate XII.) has been prepared where the seeds are shown in groups alternating with groups of seeds of standard forage crops.

A study was made of the germination of the dodder seeds.

The dodder root is the first portion to leave the seed-coats in germination, is colorless, and, while variable with the species and size of seed, near a third of an inch in length. It is distinguished from the stem by its somewhat greater size, absence of the yellowish-green that comes in the seedling when growing in full sunlight, and in its lower portion is covered with short root-hairs. These hairs are scarcely more than in name, being only papillæ upon the surface, arising from the middle of each surface cell in the area for a short distance back from the tip. In some roots the hairs come down to the tip, there being no root-cap and the end consisting of several cells of nearly equal length. The root grows very little in length as the plant elongates, and when the stem is two inches long, the root, then a third of an inch in length, is fully grown. The tip of the root is practically the same in structure, whether growing in water, sand or rich soil, with light or darkness. The normal position of the germinating plantlet is, with its root-tip, only slightly buried in the soil and extending upward, forming a "loop" in the stem, just above the root, the seed-coats, with the large supply of endosperm, still in the soil. As the growth advances the "loop" increases in size, the end of the stem finally becoming separated from the seed-coats and being lifted up free in the air, still with a "loop" near the end. After about ten days the slender wire-like stem becomes straight and the active nutrition begins.

All this time the root end has remained comparatively unchanged, fastened by the root-hairs to the soil, from which it imbibes water. The short, stout hairs are particularly interesting in presenting a movement of the protoplasm, that can be readily seen with a one-sixth objective, the flow being along the inner wall of the papilla. Under similar circumstances, ordinary seeds, like those of clover, will produce a long, slender root, penetrating deeply into the earth, showing an evident cap at the end, upon which no root-hairs appear until some distance back from the cap, and then they form as slender threads, that are very many times their diameter in length and of

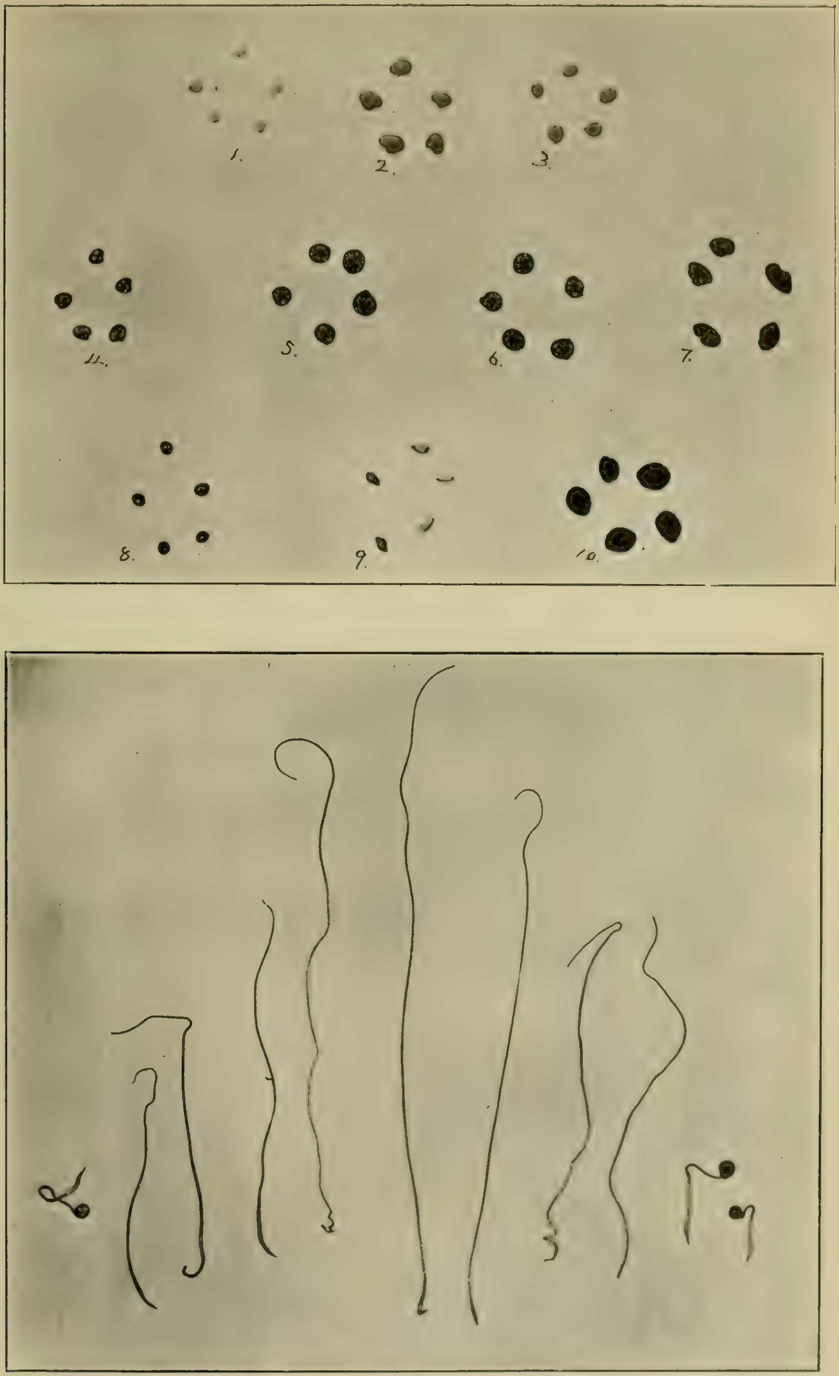

PLATE XII.

Upper—Seeds of six kinds of dodders, Nos. 1, 3, 5, 6, 8 and 10, and of red clover (No. 2), Alfalfa (No. 4), alsike (No. 7), and timothy (No. 9). Lower—Seedlings of dodder from 4 to 10 days old.

short duration. The dodder root has no means of penetrating the soil, and at best is only slightly and temporarily fastened to the soil.

The stem lies coiled up in the dodder seed, and, with moisture, air and heat added, the coats burst irregularly, the root tip protrudes, and finally the stem, like a coiled watch-spring, is pulled out by means of an upright "loop," that constantly elongates until the tip is free, it having, in the meantime, absorbed the large stock of endosperm that was packed around the embryo. The iodine test shows that the young stem, as it is being extracted from the seed-coats, is gorged with starch, the amount gradually diminishing as the root end is approached. The root itself contains very little starch, save in certain cells near to its tip.

Usually, a short distance from the end of the slender stem, there is a peculiar notch, that may be considered as locating a rudimentary leaf. The tip is also irregular, but there are none of the well-recognized elements of a formed bud.

Through the root and the stem extends a central cord of fibrous tissue, easily distinguished from the parenchyma of the main portion, that surrounds it equally on all sides. It is unbranched, and more of the nature of a tendril of squash than an ordinary stem.

Plate XII. shows various stages in the germination of the dodder plants, all selected from seedlings that were between four and ten days old. The sharp-pointed nature of the young roots, as they first come from the ruptured seed-coats, is shown in the younger specimens at the right and left sides, while the long, slender stem above the somewhat larger root portion is shown in the more central specimens. The peculiar "loop" near the small stem end is seen in some of the other seedlings. Often the seed-coats are carried up at this bend, and may be moved through circles described by the rotating stem, that very early develops the tendency to seek some object of support.

By growing the dodder seedlings upon soil covered with lamp-black, it was possible to photograph these nearly white stems. That they are much influenced by light was determined by growing the young plants in saucers, so placed that one side only received the light through a small hole in the dark chamber.

The dodder was cultivated in the greenhouse upon several host plants, the most interesting of which was that upon the buckwheat. Seeds of a species *Cuscuta Polygonorum* Eng., found abundantly upon smartweeds in the neighboring low grounds, were sown along with the buckwheat, in pots. The above species was selected because its ordinary hosts, the smartweeds, are closely related to the buckwheat. In some trials upon smartweeds in the greenhouse, it is quite evident that the buckwheat is not the first choice of this dodder ; but, nevertheless, the parasite secured a foothold and developed clusters of flowers of considerable size. There was one serious enemy to the dodder, namely, plant lice, that interfered with the experiments, and only by constant watching were any results obtained. The lice seemed to leave everything else in the greenhouse for the tender feeding ground furnished by the delicate young stems of the dodder, and were they at all numerous in clover or flax fields, it would seem that there could be no harm done to those crops by these slender plant parasites. In case of the buckwheat there was a formation of considerable enlargements of the stem at the places entwined by the dodder. Stems will make a similar growth when stung by insects, and it may be that the attacking plant so irritates the host that an abnormal growth follows. It may be an attempt on the part of the buckwheat to overcome the enemy strengthening itself at a place otherwise weakened by the enemy. Plate XIII. shows the dodder upon the buckwheat stem.

When dodders climb up woody stems of more than a year in age no such increase in size is usually met with. Along ponds and streams, alders, birches and other shrubs may be found with dodder fastened to twigs that are several years old, but they prefer the young twigs, and may reach them at the top of a button-ball bush, for example, by climbing up some vine and then spreading out upon the top of the shrub. Impatiens has a succulent stem, that is a favorite of the dodders, while any annual weed will answer for the "stepping stone" to higher feeding ground. Clematis and *Mikania scandens* are climbing plants that the little parasitic twiner finds a successful means of getting up in the world.

Notes Upon Dodder.*

* The following notes are taken largely from the Experiment Station Record:

Delaware Bulletin 5, June, 1889, F. D. Chester. Under inspection of seeds it was found that "in one hundred and forty-eight samples of seeds sold in Delaware, * * * five contained dodder." E. S. R., I., p. 24.

Colorado Bulletin 8, July, 1889. "The parasitic dodder (Cuscuta) is described, and farmers are urged to prevent its introduction with alfalfa by taking care to purchase pure seed." E. S. R., I., p. 190.

New Mexico Station Bulletin 2, October, 1890, p. 2. "The dodder (*Cuscuta trifolia*) is very troublesome in this region." E. S. R., II., p. 419.

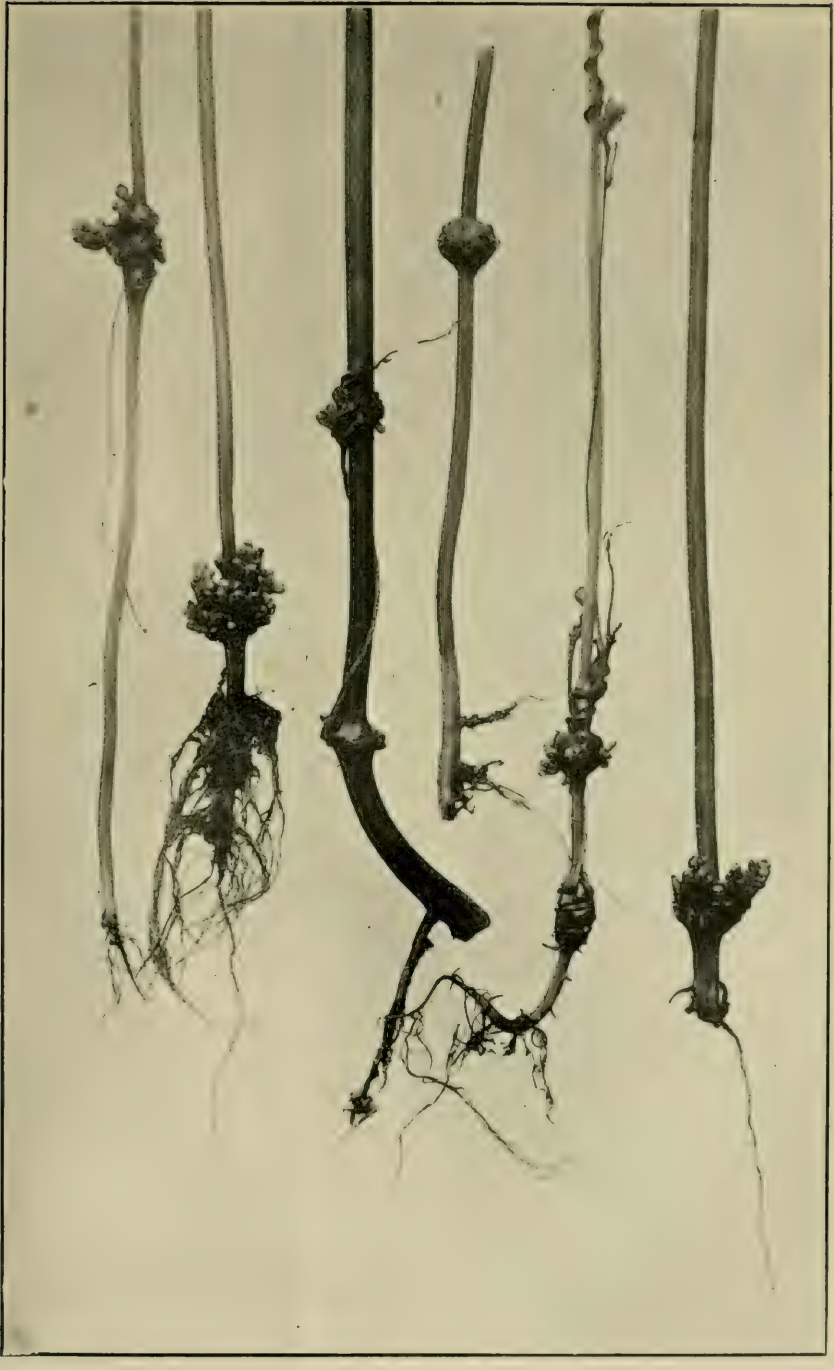

PLATE XIII.

Dodder plants as grown upon buckwheat in the greenhouse.

Nevada Station Bulletin 15, January, 1892, p. 8, Dodder, F. H Hillman (Fig. 5); gives a general account of plants of the genus Cuscuta and brief descriptions of *Cuscuta epithymum*, *C. arvensis*, and *C. denticulata*, with suggestions regarding means for the repression of these parasites. The first-named species is prevalent on alfalfa in Nevada. Seeds of *C. arvensis* were found in imported alfalfa seed. The first year's growth of alfalfa (from three seeds) showed the effect of the presence of the ,parasite in the yellowish-red patches of repressed plants, about which the dodder formed a dense mat. E. S. R., III., p. —.

Weeds of Calfornia, E. W. Hilgard, pp. 238–252, mentions in list of troublesome weeds, *Cuscuta trifolia*, *C. salina*. E. S. R., III., p. 598.

Weed Pests, L. H. Pammel, pp. 72-72, mentions dodder (*Cuscuta trifolia*). E S. R., III., p. 217.

Oregon Weeds, M. Craig, Oregon Station Bulletin 19, May, 1892, p. 21, plate 19, mentions dodder (*Cuscuta racemosa*) among "the worst weeds in Oregon." E. S. R., IV., p. 47.

Contributions from the botanical laboratory and seed-control station of Hamburg, No. 3, 1883, O. Burchard, p. 20. In the investigation for dodder seed in 60 samples of red clover, 28 were absolutely free from dodder, 4 contained from 4 to 10 per pk., and 28 contained from 14 to 11,310 per kg. The species most common was *Cuscuta trifolii*, with occasionally *C. Europea*, and more rarely *C. epilinum*. The species found in North American seed was principally *C. racemosa*. The white clover examined gave 50 per cent. dodder free, the rest containing from 12 to 684 seeds per kg. Alsike clover gave 42 per cent. free, and the rest from 36 to 1,129 seed per kg. One lot of lucern from South America contained 23,600 seeds of C. chilonsis per kg., and no samples were dodder free. Yellow clover was free from dodder in every case. In two samples of timothy 20 to 284 seeds of *C. epithynum* were found. E. S. R., V., p. 334.

Weeds of Ontario, J. H. Panton (Ontario Agricultural College Bulletin 91, November 15, 1893, p. 7, Fig. 4), mentioned among 25 worst weeds in Ontario dodder (*Cuscuta trifolii*). E. S. R., V., p. 529.

Concerning the origin of American clover seed, O. Burchard (Landw. Vers. Stat. 43, 1893), Nos. 3 and 4, pp. 239–346.

Named among a list of seeds that characterize all American clover seed, probably *Cuscuta racemosa* of that from the Eastern and Atlantic States. E. S. R., V., p. 912.

A method of destroying dodder. *C. Servais* (Ingen. Agr. Gembloux 5 (1895) No. 8, pp. 354–355). The plants on the spots where dodder is present are carefully removed and burned, the spot is worked with hoe or rake, and orchard grass or some other quick-growing species is planted on the infested spot. The author states that dodder thus treated may be entirely eradicated within two years. E. S. R., VI., p. 823.

Notes on the chemical history of Cuscuta, G. Barbey (Jour. Pharm. et Chem. 6, ses. 15 (1895) 11, No. 3, pp. 107–112), E. S R., VII., p. 407.

On the destruction of Cuscuta, L. Degrully (Prog. Agr. et Vit 12 (1895), No. 51, p. 655).

Methods are suggested for the eradication of the various species of this plant. E. S. R., VII., p 511.

Dodder on garden vegetables, B. D. Halsted; Garden and Forest 9 (1896), No. 646, pp. 565, 566, pl 1. Notes are given on a species of Cuscuta growing on onions and eggplants. E. S. R, VIII., p. 234.

An attempt to combat dodder and Rhizoctonia of alfalfa. L. Degrully. (Prog. Agr. et Vit. 26 (1896), No 31, p. 115.) The use of crude ammonia is recommended. E. S. R., VIII., p 234.

A tobacco sickness of soil (Bu. Baden Landw. Bot. Ver. Sta. (1896) abs. in Ztschr. Pflanzenkrank 6, 1896 No 3 p 185). Notes are given on the presence of *Cuscuta Europæa* on tobacco. E. S. R, VIII., p 240.

Dodder in alfalfa (Agr. Jour. Cape Colony 10 (1897), No. 11, pp. 619–620). It is recommended to cut the alfalfa from the spots where the dodder occurs and cover them with 6 inches of manure, treading it down well. This kills the dodder and leaves the alfalfa to grow up through the manure. An application of a solution of one pound of sulphate of iron per gallon kills the dodder without injuring the alfalfa E. S. R., IX., p. 143.

Cuscuta monogyna on grapes. A. Rolloff (Ztschr. Pflanzenkrank 7 (1897), No. 4 p. 213). The occurrence of this species of dodder on grape vine is mentioned, and placing finely-cut straw thickly about the vines is recommended as a preventive means. E. S. R., IX, p. 653.

Dodders infesting clover and alfalfa, L. H Dewey (U. S. Dept. Agr. Division of Botany Circ. 14, p 7, Fig. 3. Notes are given on the occurrence of some injurious species of dodder, methods of propagation, distribution and suggestions for their eradication. The species in the United States which are considered injurious to economic crops are the following: Alfalfa dodder (*Cuscuta epithymum*), flax dodder (*C. epilinum*), clover dodder (*C. racemosa chiliana*), warty dodder (*C. indecora*) and field dodder (*C. arvenses*). E. S. R., X., p. 54.

Two phanærogamous parasites of red clover, B. D. Halsted (Bull. Torrey Bot. Club. 25 (1893), No. 7, pp. 395–397, Fig. 1). Notes are given on the parasitism of Cuscuta epithymum. E. S. R., X., p. 556.

Twelve of Idaho's worst weeds, L. F. Henderson (Idaho Sta. Bull. 14, pp. 91–156, Fig. 5). Dodder is mentioned in a description of 12 worst weeds of Idaho, together with the methods of which they are distributed and suggestions for their eradication. E. S. R., X., p. 760.

Cuscuta monogyna on the grape, P. Viala and G. Boyet (Ann. Ecole Nat. Agr. Montpelier, 10 (1897–98) pp. 279-304, pl. 1, Fig. 32). A botanical study of this parasite of the grape vine. The seeds are said to retain their vitality for 2 or 3 years in the soil, and by care the plant can be exterminated from a vineyard in that time. E. S. R. XI., p. 159.

Dodder affecting alfalfa, E Schribaux (Prog. Agr. et Vit.) (Ed. L'Est), 20 (1899). No. 34, pp. 229-236; Rev. Gen. Agron (Louvain), 8 (1899), No. 8–9, pp. 373-377). The author describes *Cuscuta Gronovii* and states that it is frequently present in American clover and alfalfa seed. E. S. R., XI., 462.

The American Cuscuta, E. Schribaux (Jour. Agr. Prat, 1899, 11, No. 38, pp 418, 419, pl. 1). The author figures and describes *Cuscuta Gronovii.* On account of the fact that this species is said to be parasitic upon a number of plants, the author thinks that there is danger from its introduction into fields of forage plants. E. S. R., XI, p. 750.

Destruction of Cuscuta by copper sulphate, A. Brandin (Jour. Agr. Prac., 1899, II., No. 36, pp. 335–336). E. S. R., XI, p. 750.

The occurrence of a new species of Cuscuta on alfalfa, E. Schribaux (Jour. Soc. Agr. Brabant-Hainaut, 1899, pp 716–718).

Dodder on cucumbers under glass, F. C. Stewart, N. Y. State Station Bulletin 164, with plate. Reports the occurrence of dodder, probably *Cuscuta Gronovii*, on cucumber plants in the station hot-house. E. S. R., XII, p. 56.

The life history of flax and clover dodder, G. Wildsdorf (Fuhling's Landw. Zig., 48). Studies are reported on dodder seedlings, with reference to the host plant, the haustoria and methods of attack, and growth and reproduction of the dodder. E. S. R., XII., p. 313.

Alfalfa as a hay crop, B. C. Buffum (Wyoming Station Bulletin 43). Dodder is noted as one of the serious foes of alfafa in Wyoming. E. S R., XII., p. 431.

Geographical distribution of the species of Cuscuta in North America, A. M. Cunningham (Proc. Ind. Acad. Sci., 1898, pp. 214-215). Notes are given on the geographical distribution of the dodders into the different life-zones, as defined by Dr. C. H. Merriam. E. S. R., XII., p. 720.

The germination of ripe and half-ripe dodder seed, W. Kinzel (Landw. Vers. Station., 54, 1900, Nos. 1–2, pp. 125–132). Studies are reported upon the germination of seed of various degrees of ripeness of *Cuscuta epilinum*, *C. epithymum*, *C. plantiflora* and *C. Europæa.* It was found that the half-ripe seeds of these species retained sufficient vitality to germinate almost as readily as the fully-ripe seed. In some cases they germinated quicker than ripe seeds, and when they were found in their capsules the percentage germination was but little inferior to well-ripened seed. The author says that *C. plantiflora* is occasionally found in American clover seed. This seems to be a misstatement, as that species does not appear in any of the recent systematic treatises of the flora of this country. The species is a South European one, and its reputed presence is probably due to a wrong determination. E. S. R, XII., p. 960.

SELF-FERTILITY IN BUSH BEANS.

In order to obtain a full demonstration of the statement that beans are self-fertile, several tests were made in the greenhouse. Bush beans of the "Saddleback Wax" sort were grown in pots; as the plants neared the time of blooming all were removed, and the single plant covered with a glass bell-jar. As the flower-buds appeared, they were all removed excepting one, which was allowed to bloom entirely alone upon the plant. There were six such plants, with their single blossom isolated, and they all produced pods of normal size, possibly larger, perhaps due to the lack of competition for the nourishment, and yielded the ordinary number of seed. The last lingering doubt as to the self-fertility of this bean was removed. Similar tests were made with peas with like results, and it seems to be a fact that these species, with their strangely-formed blossoms for attracting insects, and securing wide fertilization when left to themselves, do not fail, but inbreed with apparent regularity and ease.

The Dwarfage of Beans by Cutting the Seeds.

Experiments have been made by growing "Saddleback Wax" beans from seeds that had been cut through shortwise, so that the food substance was reduced one-half. This can be done by first soaking the beans until they are softened, when they cut easily; and of the two halves, one will contain the seed-bud (plumule) and the other is made up of the free ends of the seed-leaves (cotyledons). If one is in doubt as to which is the bud end, the entire lot of halves can be planted; of course only the portions containing the stem and root will grow. Such halved beans, when planted in parallel rows with the whole beans, will demonstrate that they will germinate a little quicker than the normal beans, doubtless due to the greater ease in taking up the content of water. The plants from whole beans, however, soon pass the plants from the halved seeds, and in the course of three weeks are in every way larger. At the time when the former plants are in bloom, the others are only showing small buds. The plants from whole beans produced stems twenty-four inches high, while the halved beans gave plants only fourteen inches in height.

This experiment indicates a line of work to reduce pole beans of the common and lima sorts to bush varieties and any other plants, the dwarfage of which may result in plants of increased value.

In the second place, it emphasizes the value of a large amount of food substance in the seed and the importance of selecting those that are well provided in this respect. Large seeds other things being equal, are superior for plant production, because they have a larger percentage of material for the plant to use while getting started in the soil and air.

A similar study was made of corn, in which it was found that a large part of the starchy material may be removed, and the embryo, if uninjured, will begin growth much quicker than in a whole grain. It teaches the lesson of the advantage of rapid access of water to the center of the seed, and suggests that for large, hard seeds it may be practicable to slightly mutilate the outer portion, so that imbibition may be materially hastened.

THE SIMPLE-LEAVED AMPELOPSIS.

Specimens of the *Ampelopsis cordata*, kindly furnished by Professor Kellerman, of Ohio University, have been grown for two seasons as trellis plants upon the greenhouse. They are rapid-growing vines, with a foliage resembling the smooth-leaved grapes, which has the charm of holding on and remaining green for a month after the leaves of the American ivy have become discolored and fallen away.

Seeds of the same species were sown in the greenhouse and the seedlings set this spring in the Experiment grounds. These made a fine growth and are ready for setting as piazza covers the coming season.

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REPORT OF BOTANIST.

REPORT OF THE BOTANIST.

BYRON D. HALSTED, D.SC.
JAMES A. KELSEY, M.SC., FIELD ASSISTANT.

For the year ending November 30th, 1902, the work in the Botanical Department has been chiefly confined to experiments in the greenhouse for the winter and upon the Experiment Area during the growing season.

Owing to an enforced absence by the head of the department on account of personal illness, the field work has been in charge of Mr. J. A. Kelsey, field assistant for several years past.

Attention has been given chiefly to the breeding of truck crops, with some supplemental lines, extending into variety testing and the development of new sorts of ornamental plants.

The cross between the "Henderson" and "Burpee" dwarf lima beans has occupied considerable space, and the work of fixing the variety by selection has been in progress. Some of the reversions to the pole type have been grown and the results indicate something of value.

The cross between the "Long Purple" and "New York Improved" eggplant has been propagated largely, showing for the second year, as anticipated, considerable variation from the first type, with a tendency to go toward the "New York Improved" parent. Here selection is needed to fix the characteristics and develop a sort that is truly spineless.

The work in crossing tomatoes has gone on, and there is substantial hope of obtaining a sort that will be comparatively seedless, with remarkable vigor and uprightness of vines.

Several plots have been in crossed sweet corn, and, after four years, a combination of the "Black Mexican" and "Egyptian" is becoming established, combining the qualities of the parents in a pink variety. Some points in plant breeding have appeared in connection with the work with the corn, notably a weakness shown in albinism in connection with the in-an-in breeding.

A recent cross between the hot-house "Telegraph" cucumber, remarkable for its great length and seedlessness, and the celebrated "Znaim" variety, grown largely as a field crop in Austria, may prove of value. The work of breeding for a smooth (spineless) fruit is also progressing.

The work with a hybrid salsify is going on. Great variation is noted in vigor of plants, colors of blooms, etc., but the quality of the roots has not yet been tested.

Testing of some new importations of plants has been made.

Some of the above-mentioned lines of work were carried on in the greenhouse, and others in connection with the Experiment Area. One of the leading features of the work under glass was the testing of fungicides for a powdery mildew that is often destructive to greenhouse plants. It was found that a kerosene emulsion was a very effective remedy. It still remains to determine the most economical method of application. A study of the conditions favoring the growth of indoor mildews is needed, that rational preventive measures other than the use of fungicides may be employed.

The work with dimorphism in buckwheat was continued; also some experiments with dodders and other parasitic plants, as broom rape.

Observations as to the prevalence of the asparagus rust have been made, and, by correspondence with other station workers, some additional facts as to its habits have been obtained.

The Station herbarium has had the usual accessions from various sources during the year.

The Experiment Area.

The plan (Figure 1) upon the opposite page shows the method of plotting the Experiment Area, consisting of two acres, at the College Farm. This plan also locates the several crops that have occupied the ground during the present season.

The seven series, numbered at the top of the plan, extend up and down the slight incline of the field and are separated by four-foot paths, while the four plots, 33 by 66 feet in each series, extend right and left upon the plotted page.* Each plot is further divided the shorter way into six belts, 11 by 33 feet, as shown in the upper plot of Series 0.

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*The plan in its full details is given in the report for 1894, page 279.

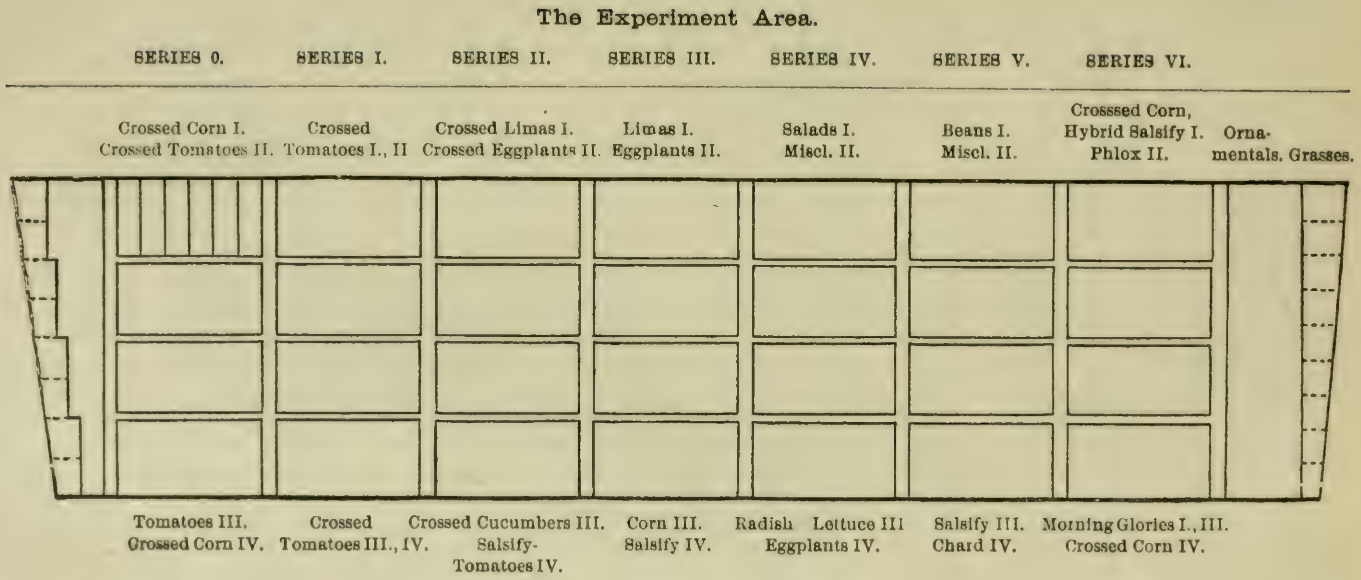
The Experiment Area.
SERIES 0.
SERIES I.
SERIES II.
SERIES III.
SERIES IV.
SERIES V.
SERIES VI.
Crossed Corn I. Crossed Tomatoes II.
Crossed Tomatoes I., II
Crossed Limas I. Crossed Eggplants II.
Limas I. Eggplants II.
Salads I. Miscl. II.
Beans I. Miscl. II.
Crosssed Corn, Hybrid Salsify I. Phlox II.
Ornamentals. Grasses.
Tomatoes III. Grossed Corn IV.
Crossed Tomatoes III., IV.
Crossed Cucumbers III. Salsify-Tomatoes IV.
Corn III. Salsify IV.
Radish Lettuce III Eggplants IV.
Salsify III. Chard IV.
Morning Glories I., III. Crossed Corn IV.

Fig. 1. The Experiment Area in 1902.

The soil, naturally gravelly clay, underlaid with yellow gravel, has been gradually improved by the addition of stable manure at the rate of twenty tons per acre for the past eight years. No other fertilizer has been used. During the winter the land has either lain bare or carried a green cover, produced by sowing rye or barley in the autumn. A special point has been made to clear up the soil after each crop and cart away and burn the refuse. The comparative freedom from disease, especially where the same crop has been grown successively upon a plot, is ascribed to this sanitary method, and is highly recommended to all engaged in growing truck crops.

EXPERIMENTS IN CROSSING SWEET CORN.

Plot IV., Series VI., was again planted with sweet corn. In belts 1 and 2 the seed used was from ears grown in the greenhouse the previous winter. These ears were from seed taken from a solid red ear, named "Extra" (X.), grown in 1901 upon the plot now under consideration. The remaining four belts were planted with grains from the ear "X.," above mentioned, and therefore, while the whole plot was planted with the product of the same ear, the first two belts bore plants one generation further from the original cross of the "Black Mexican" and the "Egyptian." In the tests for albinism (white seedlings) and other characteristics of germination, the ear in question was named "Extra" because it produced first-class plants and gave no signs of albinism.

Unlike the crop of the previous year, the plants were not large and matured more quickly than upon some of the other plots. The two belts planted with the greenhouse-grown seed produced smaller plants than the other four belts, and this was to be expected, because the plants grown in the winter under glass were slender and produced ears of only two or three inches in length, but with nearly normal diameter. The individual grains were of practically the same size as that of their parent. While the stalks in the field were below normal size, the ears were not far below those of the adjoining belts.

The first thing to be observed in the product of the two belts planted with the greenhouse-grown corn is the large number of red grains. The table below gives the number of each grains for each color for five average ears:

	Uncolored.	Black.	Red.
No. 1	15	0	365
" 2	0	0	420
" 3	36	0	360
" 4	0	0	340
" 5	20	0	380
Average	14	0	373

A similar count made for previous crop upon the same land gave—

	Uncolored.	Black.	Red.
Average 1900	172	121	92
" 1901	90	81	261

This shows that the number of red grains has greatly increased, while the white and dark grains have correspondingly decreased as a natural consequence.

The ears, while agreeing in being very nearly all red, show many differences, particularly in the number of rows of grains, and somewhat in the intensity of the red, it varying from a light pink to a dark purple. This latter variation may be in the same ear, or, upon the other hand, an ear may be solid of any one of the many shades of red.

The original red ear, "X.," was ten-rowed, those of its greenhouse progeny were ten, and the following table gives the field crop descended therefrom:

Number of 8-rowed ears	3
" " 10 " "	10
" " 12 " "	42
" " 14 " "	15
" " 16 " "	6

Belts 3, 4, 5 and 6 were planted with grains from ear "X.," above mentioned. As before stated, the plants were not quite normal size, which may be explained by the situation of the plot and peculiarities of the season. It remains to be shown whether the size and earliness are varietal peculiarities.

The following table gives the number of grains of each color for five average ears:

	Uncolored.	Black.	Red.
No. 1	60	0	444
" 2	0	0	420
" 3	10	0	550
" 4	72	0	432
" 5	0	0	480
Average	28	0	465

This is not so much of a gain in red grains as shown for the ears from the greenhouse-grown plants. This is explained above by the fact that these belts grew a crop one generation nearer to the original cross than the adjoining two belts. The greater number of grains per ear shows that upon the same plot the greenhouse-grown plants produce smaller ears than those raised in the field.

Something of the character of the ears may be gained from the following table:

Number of 8-rowed ears	6
" " 10 " "	15
" " 12 " "	38
" " 14 " "	14
" " 16 " "	6

Plate I. shows four ears from the above lot of corn. The one upon the left is untreated; the next to the right is from the greenhouse-grown seed; the next ear was close-fertilized, and the one upon the right was cross-fertilized. It remains to be seen what the relative vitality of the grains from these ears may be.

Selecting Corn for Prolificness.

The work of selecting corn for prolificness was continued the present season. Plate II. shows the two stalks that were selected in September, 1900, as the beginning of this work. One stalk is standing in its place in the plot (IV., series VI.), and another, with triple ears, is placed by its side for the photograph. It may be seen that the six ears are all evenly mixed with the dark and light grains. One stalk bore ears with eight, ten and twelve rows, respectively, and the other, ten, twelve and fourteen ears, respectively.

Samples of the results of 1901 are shown in Plate III., and the results of this selection are given upon pages 407 and 408, in the report for last year.

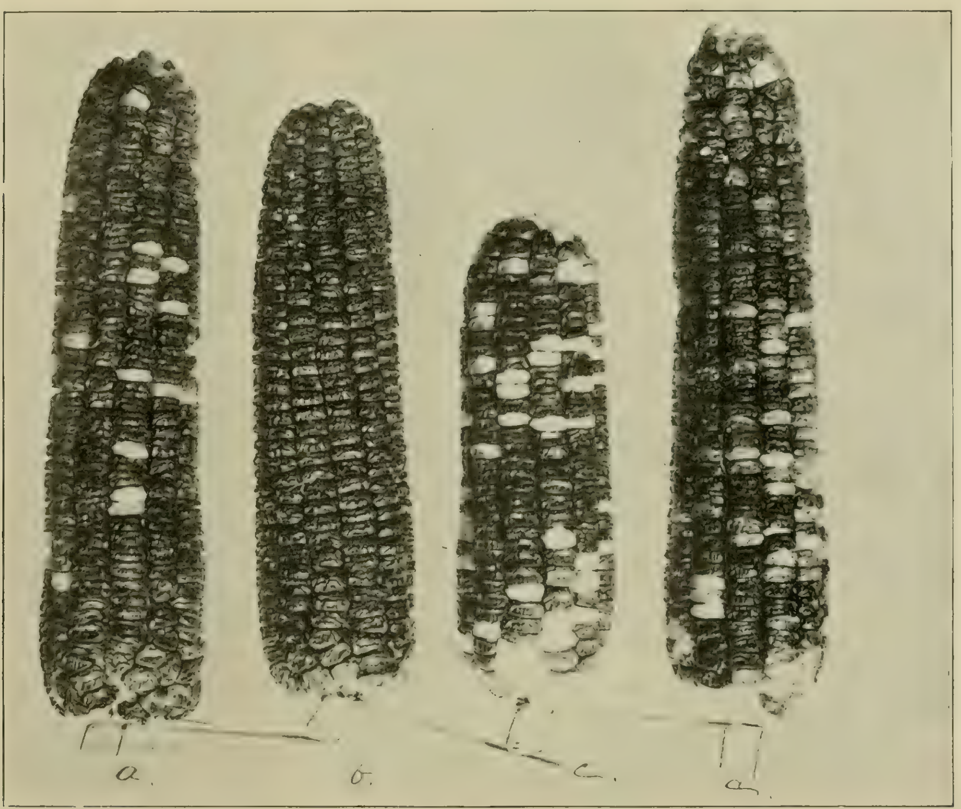

PLATE I.

Crossed Corn—ear *a*, untreated; *b*, from greenhouse-grown seed; *c*, close-fertilized; *d*, cross-fertilized.

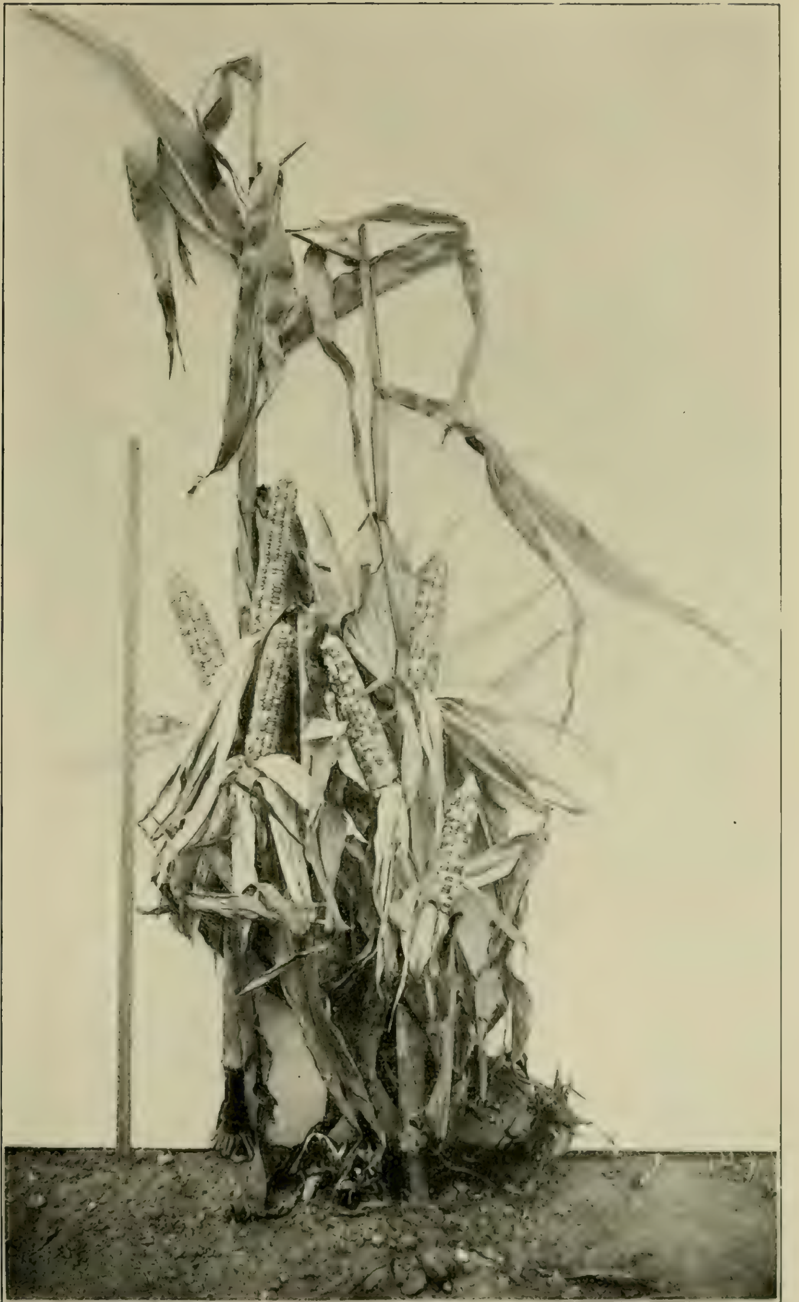

PLATE II.

Prolific Corn selected for seed from the crop of crossed "Black Mexican" and "Egyptian" in 1900.

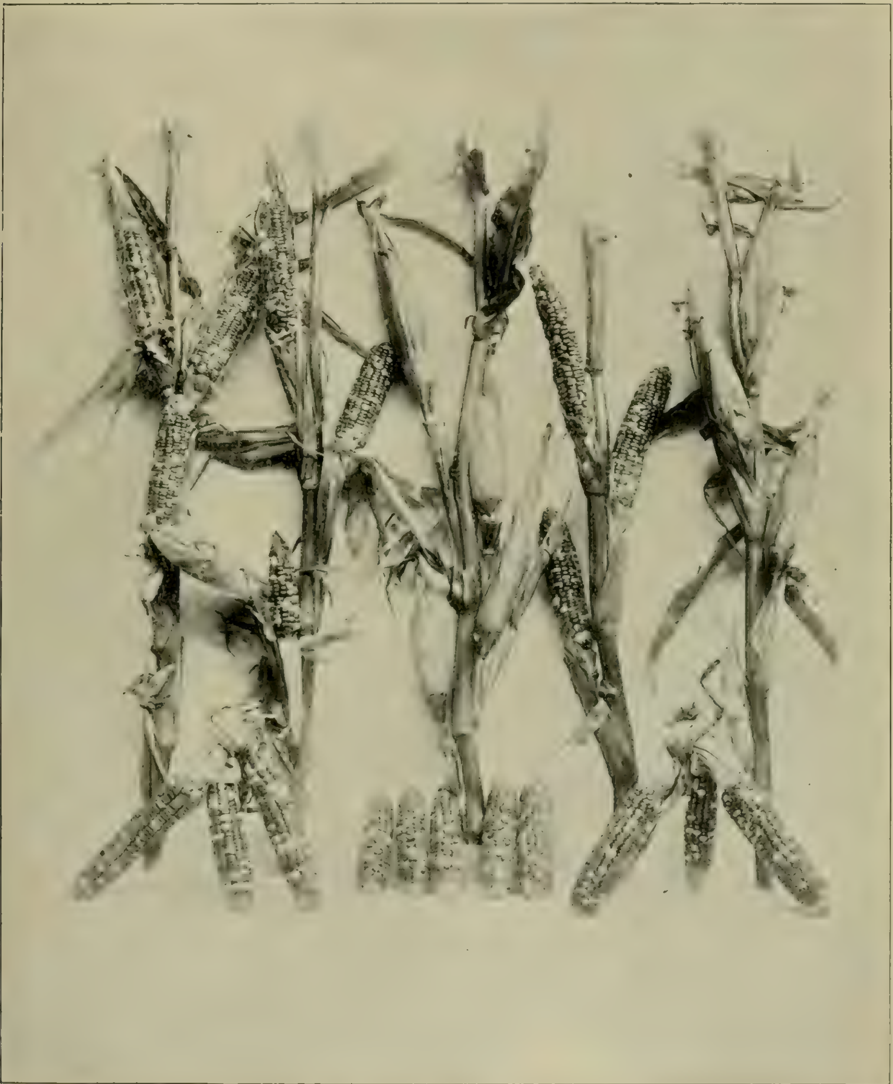

PLATE III.

Samples of Prolific Corn selected for seed from the crop of Crossed "Black Mexican" and "Egyptian" in 1901.

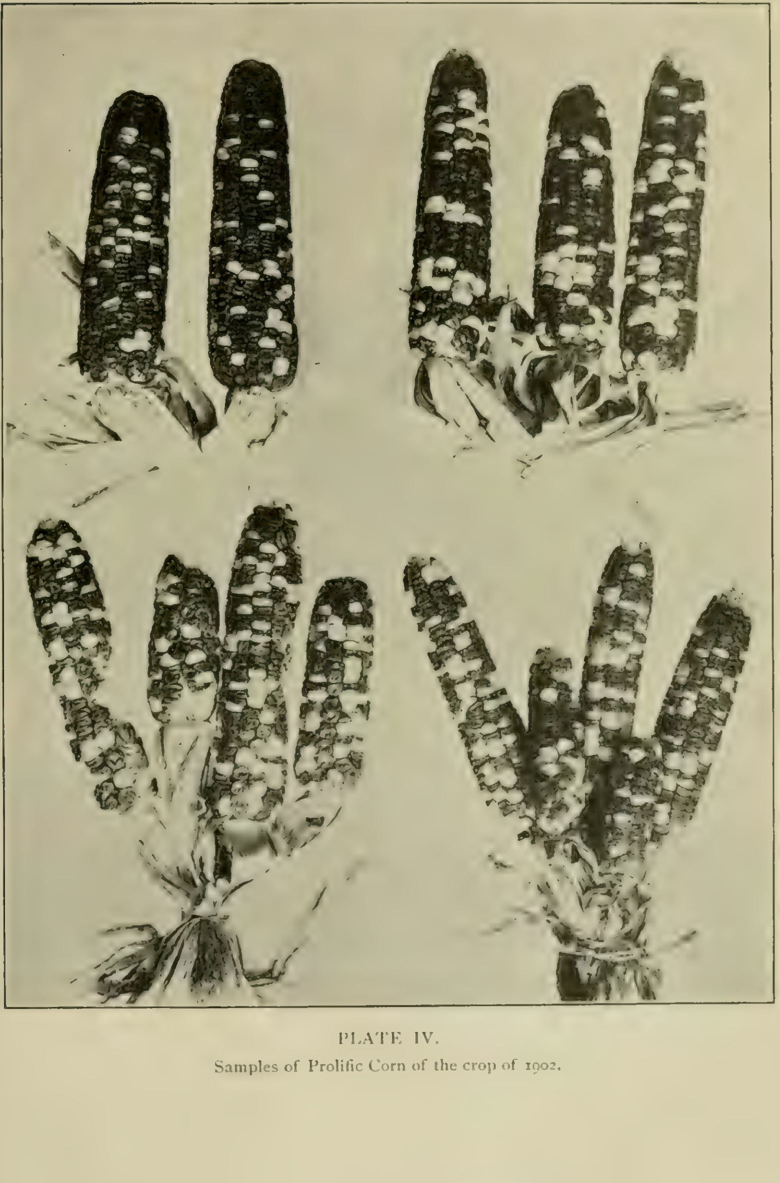

PLATE IV.

Samples of Prolific Corn of the crop of 1902.

During the present year a plot was given to a further study of the increase in yield of corn by selection. Plate IV. gives samples of the result. The corn of this plot was unusually large and vigorous. Single-eared stalks were rarely met with, the main portion having either two or three ears to each plant. There were numerous stalks with four and several with five ears. It is probable that the triplets will be selected for seed as the tendency to ear may be overdone. As two ears are better than one, when both are good, so three good ears are better than a large number, when the quality decreases.

The three plates show that the mixture of black and white grains is maintained without much change. The plan is to keep the two colors and let this breed, if established, be a mixed prolific.

EXPERIMENTS WITH EGGPLANTS.

Crossed Stock.

The crossed eggplants occupied Plot II., Series II., and Plot II., Series III. They were the representatives of four crossed fruits selected from the crop of 1901. Seeds were sown March 1st, and plants set in the field May 20th, three rows to a belt, eighteen plants in a row.

There seemed to be no practical difference between the crossed stock and the parent varieties as to the time of bloom or earliness of fruit; no such contrast as was remarked the preceding season.

A comparative record of the number of fruits produced by a parent and crossed stock was not kept, but the latter seemed to be fully as productive in 1901. Towards the close of the season the parent sorts ceased blooming, while the crossed were covered with flowers and young fruits up to the time of frost.

The plants received but two applications of soda-Bordeaux early in the season and so were practically unsprayed. The foliage was but lightly infested by the leaf blight, while the fruits, in common with those of the standard varieties, suffered severely.

In order to make the spraying of eggplants worth while, the applications during the fruiting season should be frequent—at least once in ten days, and oftener in case of washing rains. Perhaps of more importance than spraying is the careful removal of all fruits as soon as they are of marketable size, or of any smaller spotted fruits.

The shape of the crossed eggplant fruits seemed to be much the same as in the crop of 1901; not over 10 per cent. of the plants produced fruits strongly resembling the "N. Y. Improved" type, the remainder adhering closely to the "Combined" type of first season's crop.

A number of flowers were fertilized with pollen from the Early Long Purple this season, and the seeds of their fruits, together with seeds from others most nearly approaching the form desired, have been saved for further trials.

Variety Tests.

In Plot IV., Series IV., eighteen rows of eggplants were set, each row representing one of the following varieties:

Row 1. New York Improved Large Purple (Burpee).
" 2 Improved N. Y. Purple (Thorburn).
" 3. New Jersey Improved Long Purple (B.).
" 4. Fordhook Improved Spineless (B.).
" 5. Early Long Purple (B.).
" 6. Long Purple (Th).
" 7. Early Dwarf Round Purple (B).
" 8. Early Dwarf Purple (Th).
" 9. Black Pekin (Th.).
" 10. Round French (Th.).
" 11. Delicatesse (Th).
" 12. Black Snake (Th.).
" 13. Striped (Th.).
" 14. White Pearl (B.).
" 15. Mammoth Pearl (Th.).
" 16. Round White (Th.).
" 17. Long White (Th.).
" 18. Burpee's Black Beauty (B.).

Probably the above list of eighteen is scarcely representative of eleven distinct varieties. There seemed to be no appreciable difference between Nos. 1, 2, 3 and 4. Plants of Burpee's "Black Beauty" (No. 18) were not secured until late in the season, so that only two fruits were obtained. These were of much the same shape as the "N. Y. Improved" type, except that both were rendered decidedly irregular by a sort of lateral outgrowth. In color they were noticeably darker than the latter.

Nos. 15 and 16 appeared alike, and differed from the "N. Y. Improved" type chiefly in color, and, when cooked, could be scarcely distinguished from that variety. The "Black Pekin" is smaller (one-third or one-half) and almost round, while the "N. Y. Improved" is oval in form and of a lighter purple. The "Round French" is somewhere between the "Black Pekin" and "N. Y. Improved."

The "Dwarf Round Purple" sorts (Nos. 7 and 8) were alike, with fruits small and of good quality. The "Delicatesse" (No 11) appears to us very similar to the "Dwarf Round Purple." The "Long Purple" variety of Burpee and that of Thorburn seemed the same. The fruit of the "Snake" (No. 12) was long and very slender; worthless for cooking. The "Striped" was of an oval shape and about the size of the "Round Purple." The "Round White" is about the size of a hen's egg; quite ornamental; only of fair quality. The "Long White" is about half as large as the "Early Long Purple;" usually curved.

EXPERIMENTS WITH TOMATOES.

The usual amount of space in the Experiment Area has been devoted to tomatoes. The chief work has been in developing the crosses that have been described in previous reports. Further progress has been made toward a type of vine of remarkable vigor and fruit, in which the seeds are much reduced. This portion of the work was fully illustrated in the record of last year. Much difficulty is experienced in getting a combination of yellow and red color that yields a blush, and, when obtained, to have it regularly reproduced in the offspring.

OBSERVATIONS UPON SALSIFY HYBRIDS.

The third-generation plants in Half-plot I., Series VI., were from self-sown seed. Owing to their great number and irregularity, a complete color record was scarcely possible, but frequent observations were made so long as flowers were produced, and it is thought that practically all the different shades were noted and that those occurring most frequently are indicated in the following table:

	Color Chart Number.	Color.	Number of Plants.
	21	Darker red red orange	4
	22	Dark red red orange (center yellow)	2
	22	" " " " (center mottled)	5
	31	Darker red orange (center yellow)	1
	41	Darker orange red orange	1
	82	Dark yellow yellow orange	2
Parent type	93	Yellow	107
	94	Light yellow	1
	95	Lighter yellow	1
Parent type	224	Light violet red violet	150
	224	" " " " (center light)	27
	225	Lighter violet red violet	12
	233	Red violet	13
	233	" " (center yellow)	2
	233	" " (center mottled)	1
	234	Light red violet	12
	234	" " " (center yellow)	10
	234	" " " (center mottled)	6
	234	" " " (center drab)	8
	242	Dark red red violet	11
	242	" " " " (center yellow)	2
	242	" " " " (center mottled)	4
	243	Red red violet	27
	243	" " " (center yellow)	34
	243	" " " (center mottled)	30
	333	Red gray or russet	7
	333	" " " (center yellow)	14
	333	" " "	12
	334		2
	334	(center yellow	1
	355	Lighter yellow gray	7

The second-generation plants, grown in Half-plot IV., Series II., were the offsprings of twelve hybrids produced by crossing *Tragapogon porrifolius* L. with *Tragapogon pratensis* L. The greater part of the sowing consisted of a mixture of the seed of these twelve hybrids. Small portions of the seed of eleven plants were reserved, however, and each sowed by itself. The color of each parent plant and that of its offspring are indicated below:

Color Chart Number.		Color.	Number of Plants.
21		(center yellow)	..
	233	Red violet (center yellow).	1
	243	Light red violet (center yellow)	1
32		(center yellow)	..
	22	Dark red red orange	1
	25		1
	93	Yellow	1
	225	Lighter violet red violet (center light)	1
	233	Red violet	2
	234	Light red violet	1
	235	Lighter red violet	1
	242	Dark red red violet	2
	243	Red red violet	10
	243	" " " (center yellow)	12
	333	Red gray or russet (center yellow)	6
51			..
	333	Red gray or russet (center yellow)	1
94		Light yellow	..
	93	Yellow	2
	243	Red red violet	1
95		Lighter yellow	..
	31	Darker red orange (center yellow)	2
	93	Yellow	3
	95	Lighter yellow	1
	234	Light red violet (center light)	1
	333	Red gray or russet	1
	334		1
	354	Light yellow gray	1
223		Violet red violet	..
	225	Lighter violet red violet (center light)	1
	233	Red violet	1
	233	" " (center light)	1
233		Red violet	..
	233	Red violet	1
	243	Red red violet	1
233		Red violet	1
	233	Red violet	1
	234	Light red violet	1
	243	Red red violet	2
	243	" " " (center mottled)	4
384		Light violet gray	..
	234	Light red violet (center light)	1
	243	Red red violet	2

Below is given the number of plants of different shades resulting from the mixed lot of seed:

Color chart Number.	Color.	Number of Plants.
22	Dark red red orange (center mottled)	2
31	Darker red orange	1
31	" " " (center yellow)	6
41	Darker orange red orange (center yellow)	4
93	Yellow	150
223	Violet red violet	1
224	Light violet red violet	140
224	" " " " (center light)	9
225	Lighter violet red violet	1
225	" " " " (center drab)	17
233	Red violet	7
233	" " (center yellow)	10
233	" " (center mottled)	4
234	Light red violet	11
234	" " " (center light)	29
234	" " " (center mottled)	3
242	Dark red red violet	2
242	" " " " (center yellow)	3
243	Red red violet	39
243	" " " (center yellow)	30
243	" " " (center mottled)	29
333	Red gray or russet	1
333	" " " (center yellow)	20
333	" " " (center mottled)	2
334	" " " (center mottled)	3
355		1
	"Albino" plants, good size, but very pale throughout	2

Alternate rows of the two species of *Tragapogon* were sown the previous summer in Plot III., Series V.; the seed being from cross-pollenized flowers of the preceding season. Two hybrid plants appeared in 1902 in the *T. pratense* rows and six in those of *T. porrofolius*. The seed of these first-generation hybrids and selected seed of the second-generation plants in Series VI. have been sown in Plot IV., Series III.

The number of seeds produced by individual plants of the second generation has been much greater than that produced by those of the first, and plants of the third generation have been still more prolific.

EXPERIMENTS IN CROSSING LIMA BEANS.

In 1900 twenty plants were secured as probable crosses between the "Henderson" and "Burpee" dwarf lima beans. The results with the seeds from these plants are given in the report for 1901. A considerable portion of the Experiment Area has been occupied with the second generation of these crosses the present season, and the work of harvesting the crop is in progress as this report is closed. It can only be said now that there was considerable variation in the various lots, some being small-podded, prolific and early like the "Henderson" parent, while others were large-podded and comparatively late and small bearers.

Last year there were eight plants of the crosses that required poles. Seeds from these were planted separately, and, with but few exceptions, the plants have required poles. Many variations are to be met with among these, and there are indications that with careful selection a number of new pole sorts, as well as bush kinds, may be obtained in coming years. The yield upon some of the plants was quite remarkable.

CROSSED CUCUMBERS.

During last winter crosses were secured in the greenhouse of the "Telegraph" cucumber upon the "Znaim," the seeds of which were planted in Belts 1, 2 and 3 of Plot III., Series III., with good results.

The "Znaim" cucumber takes its name from a thriving Austrian town, a short distance north of Vienna, and known far and wide for the enormous quantities of superior cucumbers grown in its vicinity. Seed of this variety was kindly sent me by Mr. D. G. Fairchild, Agricultural Explorer for the U. S. Department of Agriculture. In Circular No. 2* he states that "The Znaim cucumber is a variety of *Cucumis sativus* and belongs to the field cucumber class. The seeds of this variety were brought to Znaim by a certain Andreas Lutz, servant of one of the Moravian princes. They are reported to have been introduced over one hundred years ago and to have come from the south (or Orient). The seeds were distributed throughout the county of Znaim, and from that early date the culture of this cucumber has been a lucrative one.

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*"The Cultivation of Znaim Cucumbers" Section of Seed and Plant Introduction, U. S. Department of Agriculture, January 10th, 1901.

"The statistics show that, while in 1885 only 910 acres were devoted to cucumbers in the neighborhood of Znaim, in 1895 there were fully 2,000 acres of the vegetable. The yield in 1885 was more than 150,000,000 cucumbers, while in 1895 it reached the maximum production of over 336,000,000. In the last ten years the acreage has more than doubled. The average annual yield per acre has been about 165,000 cucumbers."

The "Znaim" cucumbers were grown upon the Experiment Area in 1901, and from seed thus secured plants were obtained for the crossing in the greenhouse. The field-grown "Znaim" cucumbers were short and broad when ripe, perhaps half the length of a "White Spine," with a rough skin that was a dull yellow in color.

The "Telegraph" is perhaps the most popular indoor cucumber, and is remarkable for its length, seedlessness and firmness of tissue. Sometimes they are two or more feet in length; two inches in diameter.

One of the points in mind was to obtain a field cucumber of good size, with a superior flesh and a tendency to produce few seeds. Plate V. shows two average fruits much reduced in size. The texture of this crossed fruit is good, the shape is desirable and there are but few seeds. As in the "Telegraph," there are sometimes constrictions in the fruit where there are no seeds. It, of course, remains to determine whether the form will hold and the seediness prove acceptable.

Plot IV., Series II., was devoted to "White Spine"—"White Pearl" cucumbers, descending from the crosses of 1899. Seeds from several of the most striking variations of the previous season were sown, and, in the resulting crop, there seemed to be much less variation as to size and shape of fruits than in 1901. A majority of this year's fruits were smaller than the "White Spine" and larger than the "White Pearl." The plants from one of the selections of 1901 yielded fruits rather larger than the "White Spine."

In color, the crop, on the whole, seemed to show the influence of both parents, and in all the fruits examined there was the usual number of sound seeds. None of the fruits were spineless.

Cucumber Blight.—This season's plants became seriously infested with the cucumber mildew, but not until the fruits had begun to ripen.

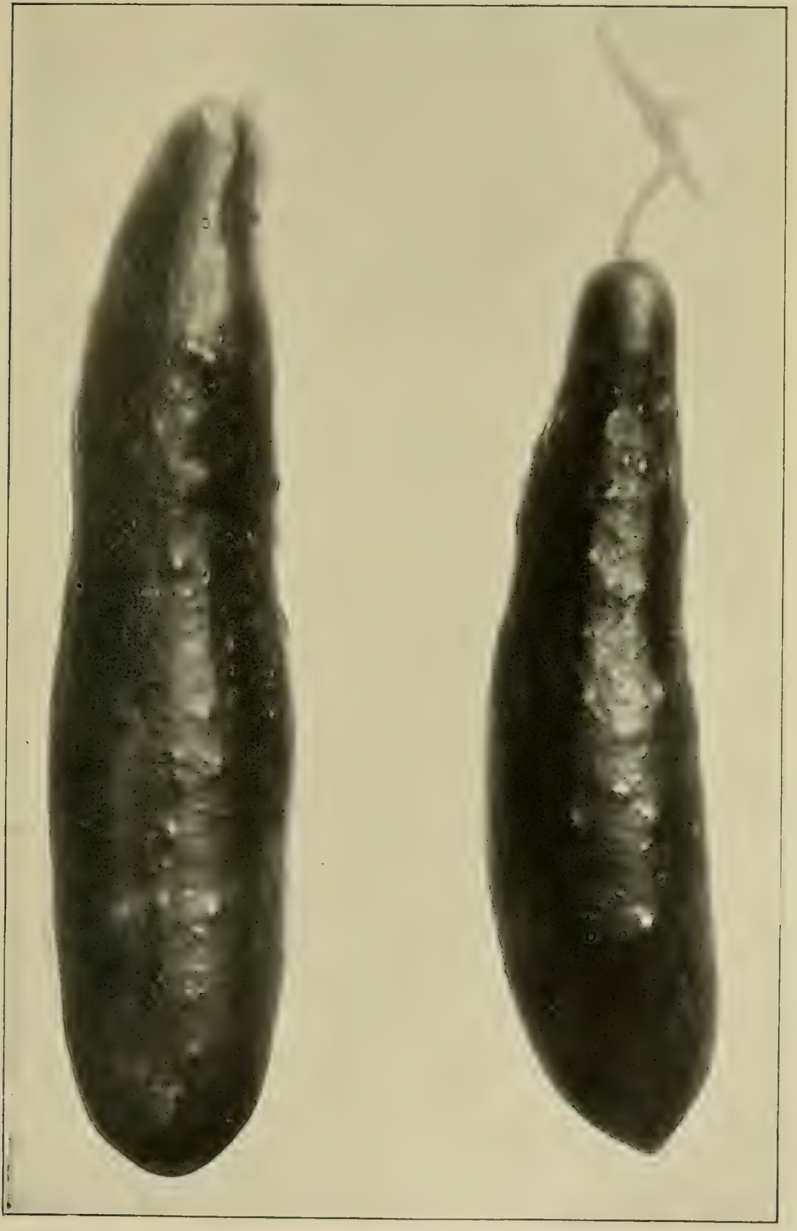

PLATE V.

Cross of "Telegraph" Cucumbers upon the "Znaim."

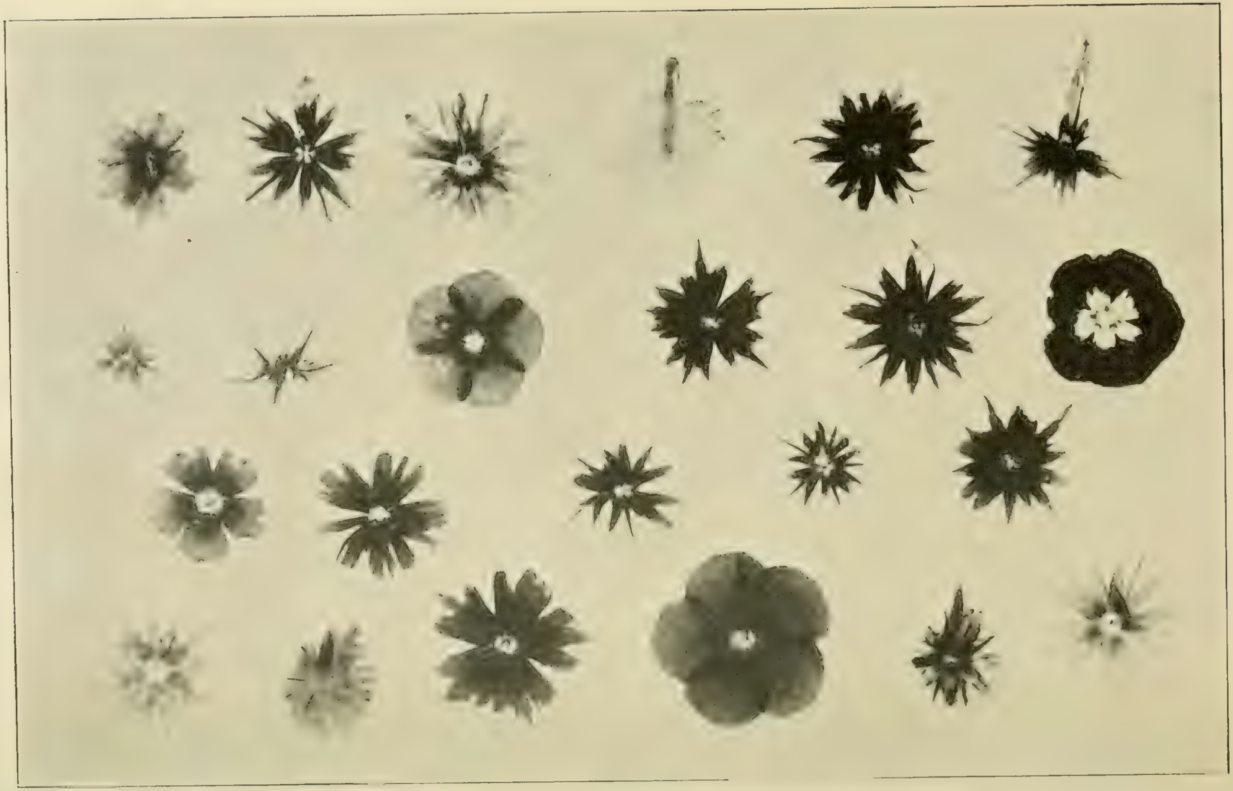

PLATE VI.

Fringed Phloxes—Various forms of flowers obtained by crossing among Phlox Drummondi.

EXPERIMENTS WITH PHLOXES.

The *Phlox Drummondii* is a native annual of great merit as an ornamental plant, and for the last two years has received attention in the Experiment Area. Twenty-four commercial varieties were grown in 1901, as listed in the report for last year. Several crosses were made in the field, and the offspring were grown to some extent in the greenhouse the following winter.

During the present season the work has been continued in the field, and a number of crosses have developed of considerable interest. The *Cuspidata* (No. 12, of 1901) variety is peculiar in having the petals extended into long teeth and giving a star-like form to the whole bloom. A number of crosses were made upon this, showing many variations of interest from the parent type. Some of these are shown in Plate VI., where the forms are easily seen, but the interesting variegation is largely lost in the photograph and engraving.

It still remains to fix some of the most attractive forms so that they will come true from seed and become satisfactory varieties for the general grower. The experience of 1901 has been repeated, namely, that the phlox is a very satisfactory ornamental plant, giving a bed of much beauty and a constant supply of handsome blooms. One can have a single solid color or ribbons of mixed shades, as the fancy suggests.

CROSSED PLANTS IN THEIR SECOND GENERATION.*

In the following statements the facts are derived entirely from observation and study of some truck crops with which breeding has been attempted during the past few years at the Experiment Grounds of the Botanical Department of the New Jersey College Experiment Station.

CORN.—In the hope of making a new variety of corn and at the same time study some of the problems in connection with plant breeding, two standard sorts were selected, one a white kind, the "Egyptian" and the "Black Mexican." It scarcely need be said that these two varieties, while both of first quality, are quite unlike in other respects than color. The "Egyptian" produces a large, white ear, with the rows of grains ten or more, while the "Mexican" has a comparatively small, black, eight-rowed ear, with the plant smaller and earlier maturing than the "Egyptian."

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*Outline of paper prepared for meeting of the Association of American Agricultural Colleges and Experiment Stations in Washington, November 19th, 1901.

By alternating the rows of hills in the plot the first year—1899—a thorough mixture of the two was secured. As the "Egyptian" had the better style of ear for the present market, the crosses upon the "Mexican" was discarded and only the pinkish grains of the "Egyptian" were selected for planting of 1901. One plot of one-twentieth of an acre was planted entirely with the pink grains from a single ear of the "Egyptian." This proved to give a very even set of plants of universal vigor, from which fully two bushels of ears were harvested. The only thing that needs further to be said concerning this result was the exceedingly uniform nature of the ears. There were none that were with all black or all white grains, but with the white and the pink so mixed that no row of grains was far from the average of all others upon the same ear or any other ear. As the pile lay before me it was easy to think that a variety of corn had been established that was an unvarying mixture of white and pink grains.

From selected ears, chosen for size and shape and number of rows upon the cob, the pink grains were used for the second planting (1901) since the mingling of the two parental varieties. The same plot of ground that was in corn in 1900 was again planted, so that any variations due to surroundings might be as far as possible removed. From the first the corn was uneven, some plants growing faster than others, while 10 per cent. were albinos and did not survive beyond four weeks or so. It was observed that many of the stalks, while quite small, matured their ears and browned before others were in the silk, while at the time of harvest in September there were certain plants still green and the grain still in the "milk."

Coming now to the ears, it was evident that the pink grains were in far larger number than the previous season. There were no ears entirely white, but some of them approached in this respect the "Egyptian" type, and in shape and number of rows this parent was decidedly in evidence. On the other hand, there were some eight-rowed ears that had all the grains of the same color and that of a dark-lead shade, approaching the "Black Mexican" type. There were other stalks that bore ears with an intermixture of white and nearly black grains, there being no suggestion of pink anywhere. Still other ears were entirely pink, no white or black showing in any of the grains. As a rose-colored sweet corn was one thing in mind at the outset, these solid-pink or pale-red ears became a hopeful indication that the end was possibly in sight.

The point that concerns us in this paper is that, while in the first year from the crossed seed the variations among the progeny was very slight and all ears showed unmistakable evidences of the cross, the same was not true to the same extent the second season. Then there was a decided tendency to depart from the form produced the year before and some plants to be small and to mature early, like the "Mexican," having the dark, solid, eight-rowed ears of that variety, while others grew large and late, with the characteristics of the "Egyptian." While no ears were solid white, there was a tendency to unequal distribution of the color; a production of an increased percentage of the pink, and, finally, some ears were entirely of the reddish grains.

Cucumbers.—This is the second season with some crossing experiments with cucumbers. In 1899 the "White Spine" and "White Pearl" were crossed. The seedlings the succeeding year were comparatively uniform in plant, flower and fruit, the latter being of good size and combining the characteristics of both the parents. There was a blending of the green of the "White Spine" with the pale color of the "White Pearl," etc. The present season forty-eight hills were planted with the seeds from the crossed fruits. It made an unusually strong lot of plants, that covered the ground with a foliage that varied among the different plants, but the range of peculiarities shown by the fruits was remarkable. They were of all colors, from the deepest green to those as white as wheat flour. Some of them were long and slender and others as round as apples. Among those with smooth skin were lying others with numerous spines, some small, other large, while not a few were striped or mottled. As the hope from the beginning was to get a smooth fruit, it looks as if the desire may be met by proper selection.

Beans.—In 1900 a cross was obtained between the dwarf Henderson and Burpee lima beans. There were twenty of the crossed plants that in themselves differed quite widely, some adhering to the Henderson and others to the Burpee type, while many were intermediate.

During the present season seedlings of these crosses have been grown, and from the time the cotyledons appeared until the harvest the plot has shown that it was a crossed lot of plants. Among other things, seven of the plants early manifested a tendency which was gratified, and they have turned out to be pole beans differing in quality of pod, seed, etc., from other pole limas—that is, while there was a reversion, it may be said, in the tendency to twine, the variety is not of either sort of ancestral type; in fact, no two of the pole plants are alike. One wonders what may come from the seed in coming years.

Tomatoes.—Crosses have been made between the small, upright, red-fruited "Dwarf Champion" and the large, spreading, yellow-fruited "Golden Sunrise" tomato. During the first season, out of 183 seedlings, all except 10 came true to the mother parent, and while it was evident that the plants were crosses, there were but few which showed remarkable peculiarities. Two were very large and produced a limited number of fruits, with comparatively few seeds. These seeds, when germinated, showed from the first a strange lot of seedlings, no two of them being alike; and most peculiar of all was the fact that many were monstrous in form, being without one cotyledon or the pumule; and such failed to live. With 40 seedlings from one of the original "Giants," a plot of ground was set, and the season's record of these plants shows a wide variation. Some were "potato-leaved," while others had foliage of a slender type; some of the plants grew entirely upright, with a very stiff stem, while others sprawled at length upon the ground; some produced red fruits of large size and others with the size of cherries, while one was plum-shape. The yellow-fruited plants were nearly as numerous and variable.

Eggplants.—Last year a cross was effected between two varieties of eggplant, namely, the "Long Purple" and the "New York Improved Spineless." These were reciprocal, the combination being to improve the quality of the "N. Y. Improved" by a union with one of small size and high quality. During this season a large number of the crosses have been raised, and the most noticeable feature of them is their nearly uniform character, whether the cross was made in one direction or its opposite. In passing, it may be also stated that the vigor of the plants was remarkable, the yield large, of fruit of high quality, and a handsome, long, pear shape, with the seeds all well down toward the blossom end. So satisfactory has this cross been the first season that all growers who have seen the plants desire some of the seed. It has been withheld upon the ground of a doubt as to its fixedness. It is not unlikely that another year will show many deviations, so that selecting will be required to establish the cross even more than one variety should they be desired.

Salisfy.—All of the above instances of plant breeding have been unions between varieties of the same species—that is, crosses. With the salsify the combination has been between two species, and the result is a genuine hybrid. The two parents in this instance were the garden salsify and the wild species. The two agree in many characteristics, but are widely different in the flower, particularly the color, which is a shade of violet in the garden sort and unmixed yellow in the other. Last year, in their first season, the hybrid plants were easily recognized by a combination of the qualities of the two species, but most readily of all by the color of the flowers, which was dark red violet. There were two types of these direct hybrids, differing only in the amount of yellow in the center of the head—that is, there were the purple red clusters and those that in distinction may be termed yellow-eyed. The type was constant upon any one plant, and number of each type was about equal. Coming to the seedlings from these plants that were grown by the hundred this past season, the case is quite different, and no less than thirty-six colors or hues found, as determined by Prang's color chart. Of these the thirteen with larger numbers out of 200 plants examined are as follows: Yellow, 10; light yellow, 12; lighter yellow, 6; darker orange red orange, 9; darker red orange, 6; darker red, 23; dark red, 13; light red violet, 9; lighter red violet, 7; violet red violet, 23; light violet red violet, 35; lighter violet red violet, 29; dark violet gray, 6. Both parents are represented and many intergrades, but the garden salsify has 103 violet reds to 28 plants that represent the yellows of the wild species. It is seen that while the first year there were two uniform types as to colors, in the second season it is far otherwise. In short, there was a wide diversity, with a strong tendency to return to the parent forms, but at the same time many intermediates.

All of the cases cited show that the second generation is the earliest moment when the real results of the cross show themselves, after which the fixing of the desired new forms must begin by selecting further breeding with one or other parent form by inbreeding or a combination of all these means.

EXPERIMENTS WITH LAWN GRASSES.

The nine plots of grass selected in the spring of 1896 have been kept closely cut with the lawn-mower during each season, and notes made from time to time upon the condition of each plot. The following table shows the species of seed sown in each plot, and the condition of the stand of grass, in percentage, for the past seven years:

Plot.		1896.	1897.	1898.	1899.	1900.	1901.	1902.
1.	Meadow Fescue (*Festuca pratensis* Huds.)	90	50	40	45	55	60	60
2.	Fine-leaved Fescue (*Festuca tenuifolia* Sib.)	5	50	40	40	40	45	45
3.	Sheep's Fescue (*Festuca ovina* L.)	10	50	40	40	30	25	40
4.	Rhode Island Bent (*Agrostis canina* L.)	80	80	90	90	90	95	95
5.	Wood Meadow (*Poa nemoralis* L.)	60	65	70	85	80	85	90
6.	Kentucky Blue (*Poa pratensis* L.)	50	65	90	90	85	85	80
7.	Rough Meadow (*Poa trivalis* L.)	90	65	70	70	45	70	60
8.	Redtop (*Agrostis alba vulgaris* With.)	100	90	70	60	25	25	20
9.	Perennial Rye (*Lolium perenne* L.)	100	85	70	40	20	15	15

It is seen that the "Rhode Island Bent" holds up well, and the stand this autumn, at time of last inspection, was near perfection. In the dry weeks of summer it becomes brown, and for this reason the present rating may be high. It is exceptionally fine in texture. The "Kentucky Blue Grass" has proved very satisfactory for the last three years, but some weeds have crept in the present season and lowered the percentage somewhat. In the "Wood Meadow" plot the grass has held its place for three seasons. The "Meadow Fescue" has made a gain this season over the previous year. Being at one end of the rows of plots, it is favored by a border gutter along the side of the plot. The "Redtop" shows a poor stand and the "Perennial Rye Grass" is nearly gone out. The leading weed in autumn is the crab grass, that fills in all vacancies. There are some dandelions that have not been removed from these test grounds.

EXPERIMENTS WITH WEEDS.

A piece of ground 11 by 33 feet, called "the weed belt," has been continued for the sixth season.

The fourteen most prominent weeds in this neglected area in 1902 were the following:

1. *Rumex acetosella* L. (0), (7), (4), (3), (1), (1).
2. *Daucus Carota* L. (12), (0), (0), (4), (5).
3. *Bromus racemosus* L. (0), (0), (0), (0), (2).
4. *Polygonum Pennsylvanicum* L. (0), (6), (3), (2), (2), (4).
5. *Abutilon Abutilon* L. (7), (2), (6), (6), (3).
6. *Chrysanthemum Leucanthemum* L. (0), (0), (0), (9), (6).
7. *Silene noctiflora* L. (9), (13), (14), (7), (7).
8. *Taraxacum Taraxacum* L. (0), (0), (9), (5), (8).
9. *Convolvulus arvensis* L. (0), (0), (0), (0), (9).
10. *Melilotus alba* Lam. (0), (0), (0), (12), (10).
11. *Oxalis stricta* L. (0), (0), (0), (8), (11).
12. *Ambrosia artemisiæfolia* L. (3), (5), (1), (1), (14).
13. *Aster* Sp.
14. *Rudbeckia hirta* L. (0), (0), (0), (0), (13).

The number in parentheses indicates the rank that each kind of weed held in previous years, beginning in 1897.

Other weeds, arranged in the order of their importance, were—

1. *Chenopodium album* L.
2. *Plantago Rugelii* L.
3. *Rumex crispus* L.
4. *Arctium Lappa* L.
5. *Panicum sanguinale* L.
6. *Barbarea Barbarea* (L.)
7. *Hibiscus Trionum* L
8. *Polygonum Convolvulus* L.
9. *Acalypha Virginica* L.
10. *Amarantus retroflexus* L.
11. *Plantago lanceolata* L.
12. *Ixophorus glaucus* (L.)
13. *Aster*, 2 species.
14. *Tragapogon pratensis* L.
15. *Tragapogon porrofolius* L.

Trifolium repens and *T. hybridum* were prominent in 1901 and were equally conspicuous the present season. Occasional plants of *T. pratense* were observed; one tomato plant, a three-year old grape vine and a young cherry tree.

Weed Notes.

HORSE-NETTLE (*S. Carolinense* L.).—Mr. Polhemus, of Rocky Hill, handed the Director a specimen of this weed for identification, stating that it was becoming troublesome in the meadows in his neighborhood.

CORN CHAMOMILE (*A. arvensis* L.).—The manner in which this plant can adapt itself to conditions may be seen in one portion of the College campus. Instead of being destroyed by frequent clippings of the lawn-mower, its usually erect or nearly erect stems have become prostrate. Roots are put forth from their joints, binding them closely to the ground, and one plant will spread over a considerable area in a single season.

GROUND IVY (*N. Glechoma* Benth.).—In some of the lawns about New Brunswick this weed is becoming quite conspicuous.

AILANTHUS (*A. glandulosus* Desf.).—The owner of a lawn containing a few ailanthus trees is annoyed during late summer and fall by the great number of ailanthus seedlings. One of the trees was cut down in the spring, and from its large "surface" roots many sprouts were sent up throughout the season.

NOTES UPON CLUB-ROOT.

Since the announcement of the proposition that the cancer in the human subject, particularly of the stomach, is due to an organism closely related to and perhaps indentical with the *Plasmodiophora Brassicæ* Wor., there has been a new importance placed upon the club-root fungus.

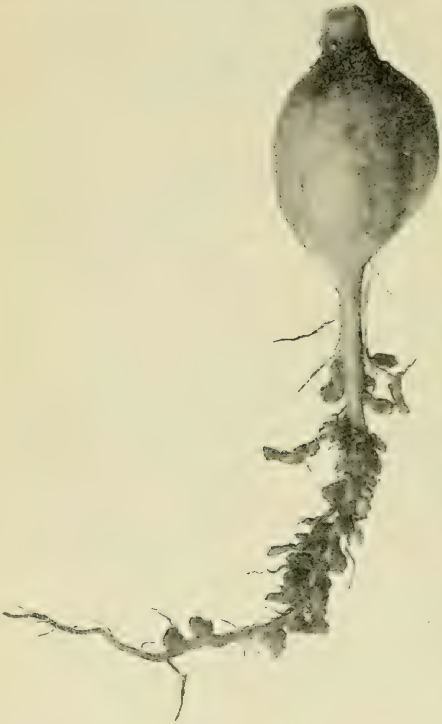

Fig. 2.
Club-root of Radish.

In case of the cabbage, the root is not eaten, and the edible portion of the "head" is rarely if ever infested by the organism causing the offensive cancerous growths in the root systems. With turnips, which are equally infested with the disease, the germs might find ready access to the alimentary canal. In the process of cooking it is probable that the fungus would be killed, but children are fond of raw roots, and, thus eaten, they might cause the lodgment of the live germs, where they, perhaps, would prove mischievous. Any badly-diseased turnip would naturally be rejected by all, but it is in those very slightly diseased that resides the most danger. In cutting away of an excrescence from an otherwise normal turnip there might be quite a portion of the infested tissue left behind, which, when eaten raw or after partial cooking, might prove injurious.

Radishes are usually eaten raw, and thus the germs might be introduced, especially when the fungus does not produce any striking distortion and the root seems unaffected. This latter is usually the case with radishes, but that they are subject to the club-root disease is shown by the accompanying engraving (Fig. 2) of a specimen grown upon the trial grounds the present season. In this instance only the slender, lower portion of the root shows the galls, but not unlikely the edible part is also infested.

So long as there is strong suspicions that cancer is induced by the club-root germs in the roots of turnips, radishes and other cruciferous plants, it is well for people to be upon their guard and eat only healthy roots.

THE MILDEW OF LIMA BEANS.

Late in September numerous complaints of trouble with lima beans, with specimens, were sent in to the Station. The disease proved to be the mildew (*Phytophthora Phaseoli* Thax.) and merits a consideration here as being among the most destructive of the fungus troubles of the year.

The following is from Bulletin No. 151:* "This fungus was first described by Dr. Thaxter† and later more fully‡ considered by him, with engravings, some of which are herewith reproduced through the courtesy of the Connecticut Experiment Station. While the fungus is very easily seen in itself and also indirectly prominent from the destruction it produces upon the affected lima bean plants, its native home is somewhat of a puzzle, as evidenced by the following lines, written by its discoverer: 'Its origin * * * is purely a matter of conjecture, since, although it seems scarcely probable that so conspicuous a form should have been overlooked in so thoroughly explored a region as the New England and adjacent States, it has been equally overlooked in other parts of the world, if indeed it is a foreign importation.'"

It was not long before the mildew was met with in other States, and at the present time it is a serious menace to the growers of lima beans in New Jersey. The records show, for example, that the disease has been abundant in Bergen county. "Here the pole limas were so badly attacked that few or no pods were picked from some of the fields. The mildew was worse with plants growing upon rich lowlands and where the same crop had been upon the ground the previous year."* Not only the young pods, but the whole flower clusters were destroyed, and the dead tips of these stood up above the surrounding leaves of the affected plants. The general appearance of the mildewed pods is shown in Figure 3, the engraving having been made

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*"Bean Diseases and Their Remedies."

†Botanical Gazette, vol. 14, p. 273, November, 1889.

‡Conn. Agr. Exper. Rept., 13, 1889, pp. 167–170.

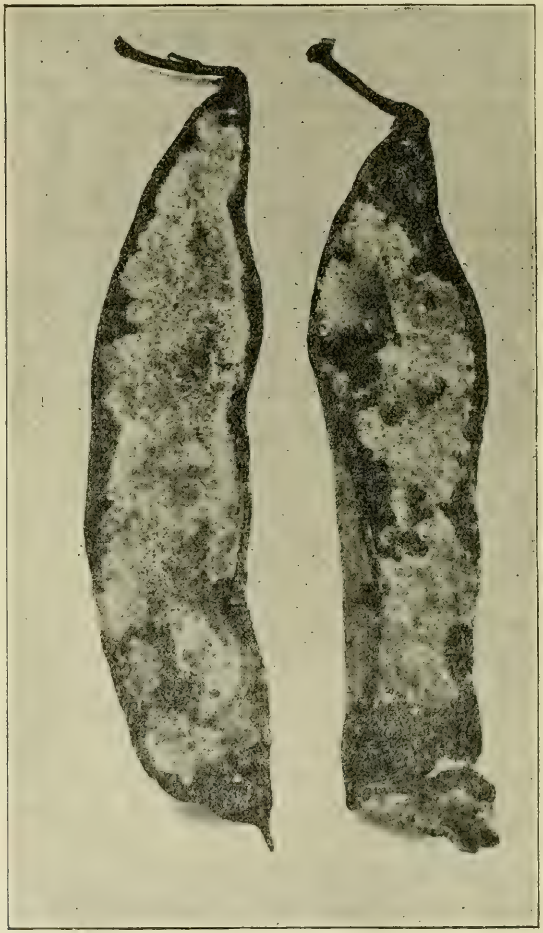

Fig. 3.
Lima Beans Affected with Mildew.

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* Rept. N. J. Exper. Sta., 1897, p. 297.

from a photograph of two diseased pods, while the ruined flower clusters are similarly shown in Figure 4.

A microscopic examination of the affected part of the plant shows that it is penetrated by the slender threads of the fungus, which come to the surface and there produce tufts of branching filaments and bear multitudes of spores, all of which constitute the light mouldy covering and suggests the common name of downy mildew that is given to many members of this family. For example, there is a closely-related

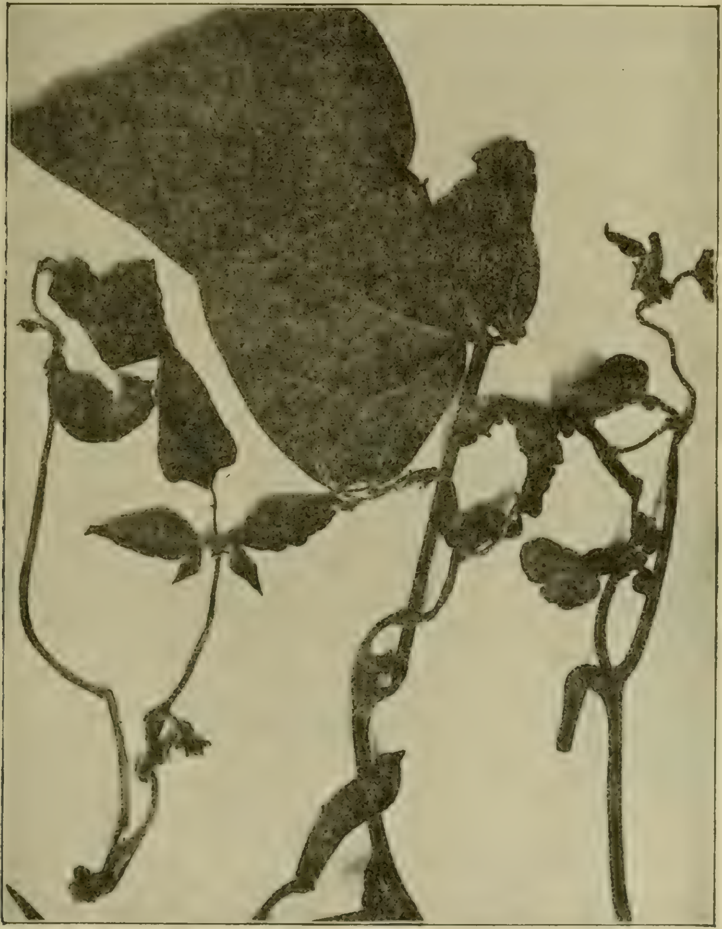

Fig. 4.
Lima Bean Flowers Ruined by Mildew.

mildew of the grape, another of indoor lettuce, another of onions, while the potato-rot fungus, often extremely destructive, is very near of kin to the bean *Phytophthora*. Figure 5 gives some of the microscopic details of the mildew. At *a* is shown a portion of the diseased bean pod with the threads passing through the stoma and bearing the spores upon their tips. A more enlarged view of the mildew is shown at *b*. The enemy in question belongs to a group of fungi the members of which are among the most fatal of all that afflict crop plants, and therefore demand prompt attention upon the part of the grower when met with.

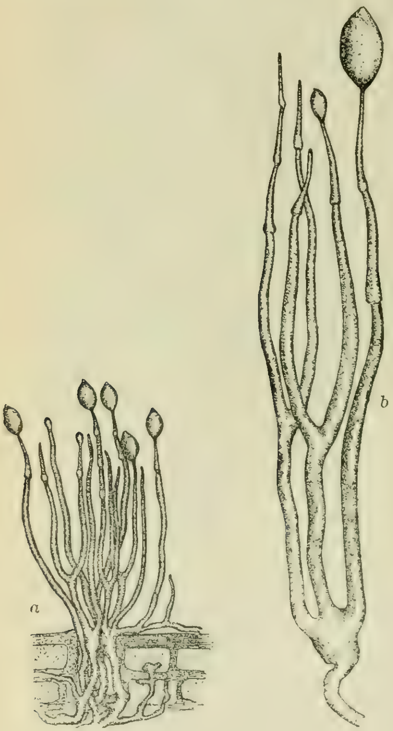

Fig. 5.
Microscopic Details of the Mildew.

Precautions.—Some hints as to precautionary measures may be gained by a knowledge of the habits of the group to which the mildew of the lima beans belongs. After a somewhat prolonged study of the relation obtaining between the weather and the development of fungi, it may be confidently asserted that there is no group that is more influenced by prevailing moisture than the downy mildews. The potato-rot fungus (*Phytophthora infestans* DeBy.) is particularly fond of wet weather, with high temperature, and the records show that 1899, the year when the bean Phytophthora was discovered, was remarkable for its excessive summer and autumn rains. In the case of greenhouse lettuce it is found that sub-irrigation is almost a complete preventive of the mildew, otherwise often quite destructive. It is safe to assume, therefore, that the amount of the bean mildew will depend quite largely upon the amount of moisture, and, in a dry season, but little damage may be expected from it. But the rains cannot be controlled, and therefore the factor of precipitation remains an uncertainty. This much can become a practical matter, namely, the shunning of all lowlands that are apt to be wet. In other words, favor the higher and drier land for lima beans, because in such situations the mildew will be less certain to gain a foothold.

Dr. Sturgis* concludes his report of the remedies for the mildew as follows: "While from the nature of the disease it would seem probable that the use of fungicides would present many difficulties, yet, from experiments in which Bordeaux mixture, ammoniacal copper carbonate solution, sulphur and potassium sulphide were used, it appeared that when three applications of Bordeaux mixture was followed by two applications of ammoniacal copper carbonate solution the amount of the disease was greatly reduced.

"The conclusions drawn from the experiments with fungicides show that even in a season most favorable for the lima bean mildew, a thorough treatment of the vines with Bordeaux mixture will insure a crop. The selection of well-drained land and a light soil, reducing the number of vines in the hill and planting the poles erect, will insure conditions as little favorable to the development of the fungus as possible."

THE ASPARAGUS RUST.

In our own State, the following may stand as representative for the region centering in Middletown, Monmouth county, where large areas are devoted to asparagus for the New York market. Mr. James C. Hendrickson reports: "The asparagus fields look unusually well for this time of year. There has been very little rust this fall. Most of the 'Colossal' beds are gone. The 'French' and 'Palmetto' beds are now showing a little rust. I do not see much difference; if any, it is slightly in favor of the 'French' sort. The crop, I think, has been an average one considering the past six years." Mr. Charles Tindall, of New Monmouth, writes that "The crop was larger than the previous year, partly on account of warmer weather and sufficient moisture in May; also because of less rust in the fall before. The quality was also good. The growth of top is not as heavy as last year, caused by the dry weather at the time of plowing off the beds the last of June. The rust made its appearance about the first of September in a light form, but too late to materially affect the crop, excepting where it was neglected in cultivation or badly infested with the beetle. To my knowledge there are only the two varieties in this section, 'Palmetto' and 'French Argenteuil,' and, so far as I have been able to ascertain, there is no material difference in regard to the rust, both being affected about the same. Seedlings that have been cared for well are practically free from rust and are looking very well."

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* **Report Conn. Exper. Sta. 1897, pp. 159–160.**

For the southern section, providing asparagus for the Philadelphia market, Mr. John G. Whitall, of Woodbury, writes: "The crop the past season was a fair one, but the rust is now probably worse than ever before, many of the fields being entirely dead. The rust did not make its appearance as early in the season as usual, but since appearing has been very destructive. The 'Palmetto' does not show the effects of the rust nearly as badly as other varieties. In one or two cases, where beds of 'Palmetto' have been kept entirely free from grass and weeds, the rust does not seem as bad as where these have been allowed to grow."

For Vermont, Mr. W. J. Morse, Assistant Botanist of the Experiment Station, reports: "We have been on the lookout for it for several days and have found very little of it, where in years past it has been quite prevalent. Professor Jones is of the opinion, therefore, that it is not occurring as much in this locality this year as usual."

For Massachusetts, Professor Stone writes: "I think I can say, in general, that this year has been a very good one for asparagus. By that I mean there has been very little rust. We have had plenty of rain all through the season, and, according to my theory of rust infection, we should not expect much in such a season. I know that they have it on Cape Cod to some extent, but one large grower told me that it was far less than during other seasons. Our beds at the College at the present time do not show a particle of the fall stage. I saw a good illustration of spraying this summer with Bordeaux mixture alone. One small bed was divided into two sections, one-half of which was sprayed and the other half not. The gain on the sprayed portion was enormous compared with the unsprayed. This was done by a man who owns sixteen or seventeen acres of asparagus, and he certainly covered his plants thoroughly with Bordeaux. They were covered so thoroughly with Bordeaux, large and small branches, that they had the appearance of a blue spruce. This experiment convinces me that if plants are thoroughly covered, every portion of them, with the Bordeaux mixture, that good results can be obtained. The difficulty has been, however, to thoroughly cover the plants with Bordeaux mixture."

Professor Stewart writes for New York: "I am sorry to say that I can give you little definite information except for eastern Long Island. I have just returned from a trip to that section, and I find that there the rust is somewhat more destructive than it was in 1901. Many of the young buds are considerably injured by the disease, the plants being already dead or brown, but the majority of the older beds are only moderately affected and are still very largely green. The few beds which I have observed in Central New York are very slightly affected, and my impression is that there is not much of the disease in this part of the State."

From Delaware, Professor Chester reports as follows: "I have found the rust generally prevalent throughout Delaware during the present season, but probably not more abundant than last year. I have, however, only general impressions to convey on the subject."

Professor Buckhout writes for Pennsylvania: "Up to the time of receiving your letter I had not noticed any asparagus rust on our bed, but on looking it over to-day I find there is quite a showing, though hardly so much as in previous years; certainly no more. I may say that we have done no spraying and that our bed is small, scarcely, if any, over one-fourth acre. The general course of the growing season has been as follows: A dryer than usual spring, culminating with unsasonably dry, dusty weather up to June 10th. Rain then began and was almost daily until about July 15th to 20th, when there was a gradual diminishing until August 1st. August was midsummer dryness, unbroken by rain until September 12th, but no rains of consequence until September 25th."

For Virginia, Professor Alwood sends the following: "This year the asparagus rust has appeared in our plantations here. As it appeared in some young plants set last spring, I have no hesitancy in saying that the fungus must have been brought from the nursery. These plants were purchased at a small nursery near Richmond, which would go to show that the territory is infested: and I doubt not that this disease is prevalent about Richmond, as it is at some points along the coast."

Professor Selby reports for Ohio: "I can give you but little new information concerning asparagus rust. Indeed, I have no definite notes save the general one that it has become spread over almost the entire State, locally."

Professor Arthur reports from Indiana: "The rust in Indiana did not appear very early this season, but it was general, probably few or no patches of plants escaping. While destructive, it does not seem to have been uncommonly so, as might have been supposed from the wet season. No æcida have yet been found within the State. Here at Spirit Lake (Iowa) I find the rust, but there is so little of it as to be economically unimportant. At Decorah, Iowa, as you may be aware, Mr. Holway found æcida on onion leaves, close to rusted asparagus plants (and nowhere else), which, in the light of Mr. Sheldon's studies (reported in *Science*), appears to indicate that asparagus rust is not confined to a single genus of host plants, at least in the æcidial stage. Whether *Puccinia Porri* is identical with *Puccinia Asparagi* or not it would be rash to say. It is safer at present to assume that they are distinct, but that the latter may occasionally produce æcidia on onion almost or quite like the æcidium of *P. Porri* in morphological characters."

Doctor Burrell reports for Illinois: "The asparagus rust has appeared in many new places in various parts of Illinois during the last year, and it has been found within that time in quite a number of places where it had been earlier introduced, but of which we had no previous knowledge. I think, all told, there must be at least one hundred separate locations of the disease now in our State. I have had no practical experience in combatting it and have no definite knowledge as to its extermination within our borders. It is true, however, that certain statements have been made by practical growers, going to show that they have kept it down by spraying with Bordeaux mixture. I have no definite evidence concerning anything about the disease now save this fact—that it is evidently increasing considerably with us, and I think it is doing a good deal of damage."

For Iowa, Professor Pammel writes: "The *Puccinia Asparagi* is on the increase, but I have no extensive reports from other sections of the State, and I notice that additional plots are affected in this vicinity."

Professor Bessey writes for Nebraska: "Mr. John L. Sheldon, Instructor in Botany in the School of Agriculture, who has made this rust a special study for a number of years, says that there is not as much this year as last. In regard to the possible connection between the abundance of rust this year and the peculiarities of the season, he says that of course this season has been wet and the rust less abundant. Whether there is any connection between these two points he is not prepared to say. However, he says that there is less rust on low land than on high land, and you may put this fact with the other and make what you can out of it. Many people burn the brush at the end of the year, and where this is done there is now little or no rust. In some instances the owners, after burning the brush, run over the ground with a disc cultivator, and this seems to do some good also. In a particular case, near Lincoln, the asparagus is grown in an orchard where burning and other precautions cannot be resorted to, and it is a fact that there is more rust in this asparagus plot than elsewhere. Still the season is one which is characterized by a small amount of rust on the asparagus."

Professor W. R. Shaw reports for Oklahoma: "I have neither seen any of the rust nor received any report of its occurrence in Oklahoma and Indian Territories, and Mr. Morris, our Horticulturist, informs me that he has never met with this rust in this region."

Professor Saunders sends the following for South Dakota: "I have nothing in particular to report with reference to the asparagus rust. The only two patches of asparagus that I know of were so badly infested last year that they were plowed up and destroyed last fall. A few scattering volunteers in our timber claim were quite as badly infested this year as was the patch of asparagus last year."

For North Dakota, Professor Bolley sends the following: "This time I am able to report to you that the asparagus rust is here with a vengeance. I am unable to give you any information regarding the influence of weather upon the disease. Last year we had a very dry season. The plot at the College, which is a large one, rusted some time in August, so as to be thoroughly brown. This spring has been an extremely wet one, so there was an abundance of moisture in the ground at all periods of the growing season, and this College bed was struck by rust so as to be thoroughly killed by the 15th of August, so dead that we cut it all down and are making some experiments as to the further effect of the rust, how to control it, etc. This bed at the College is one of the oldest asparagus beds in the country and has become thoroughly infested. Last year, on my own lawn, my bed of asparagus was killed by rust. I pulled all of the old stalks out of the bed, burned them up and covered it with ashes. The bed this year has borne no rust, but I simply consider it an accident; do not know why the plants have staid green until frost. The rust is spreading through the State, I know, because I have found it upon volunteer asparagus on numerous tree claims."

Professor Nelson makes a favorable report for Wyoming: "I again have the pleasure of reporting that the asparagus rust has not made its appearance in this State so far as I have been informed."

Professor Balmer, of Washington, sends the following: "I have seen no asparagus rust in this State, nor have I heard of any."

For California, J. J. Keegan, Secretary of the State Board of Horticulture, writes: "I beg leave to acknowledge receipt of your reports for 1899, 1900 and 1901. for which please accept my thanks. The information they convey will be of the greatest value to this Board.

"We are trying by all means in our power to prevent the introduction of the asparagus rust into this State. This Board has passed a resolution prohibiting the introduction of all asparagus roots and seeds from any place outside of California into this State. By this means we hope to escape it.

"The asparagus industry is rapidly becoming of the greatest importance, fields of 1,000 acres and upwards having been planted on the islands in the delta of the Sacramento and San Joaquin rivers, and the coming season many more will be added. Should the rust be introduced it would all be ruined, as the islands are very low and moist, protected by levees from overflow and most favorable to the propagation of fungus growths."

Asparagus Rust on the College Farm.

On October 23d a final inspection was made of the several varieties in the four plots. The field generally showed much rust and the brush was not vigorous. The larger size and deeper green of the "Palmetto" variety was evident from all parts of the field. The "Argenteuil" was little infested. Upon a basis of percentages, as assigned to the amount of rust in former years, the "Palmetto" and "Argenteuil" show 25 per cent., while the "Mammoth," "Elmira," "Columbian," "Colossal," "Brunswick" and "Cross-bred" have 75 per cent. of rusting.

Last year the percentages were 20 and 50. It was noted that the least rust was upon the plot where barnyard manure had been applied.

BROOM-RAPE UPON COLEUS.

The greenhouse during last winter was employed in part in testing the habits of certain seed-bearing parasites, as the dodders and broom-rape. It is interesting to note that a coleus plant standing near these

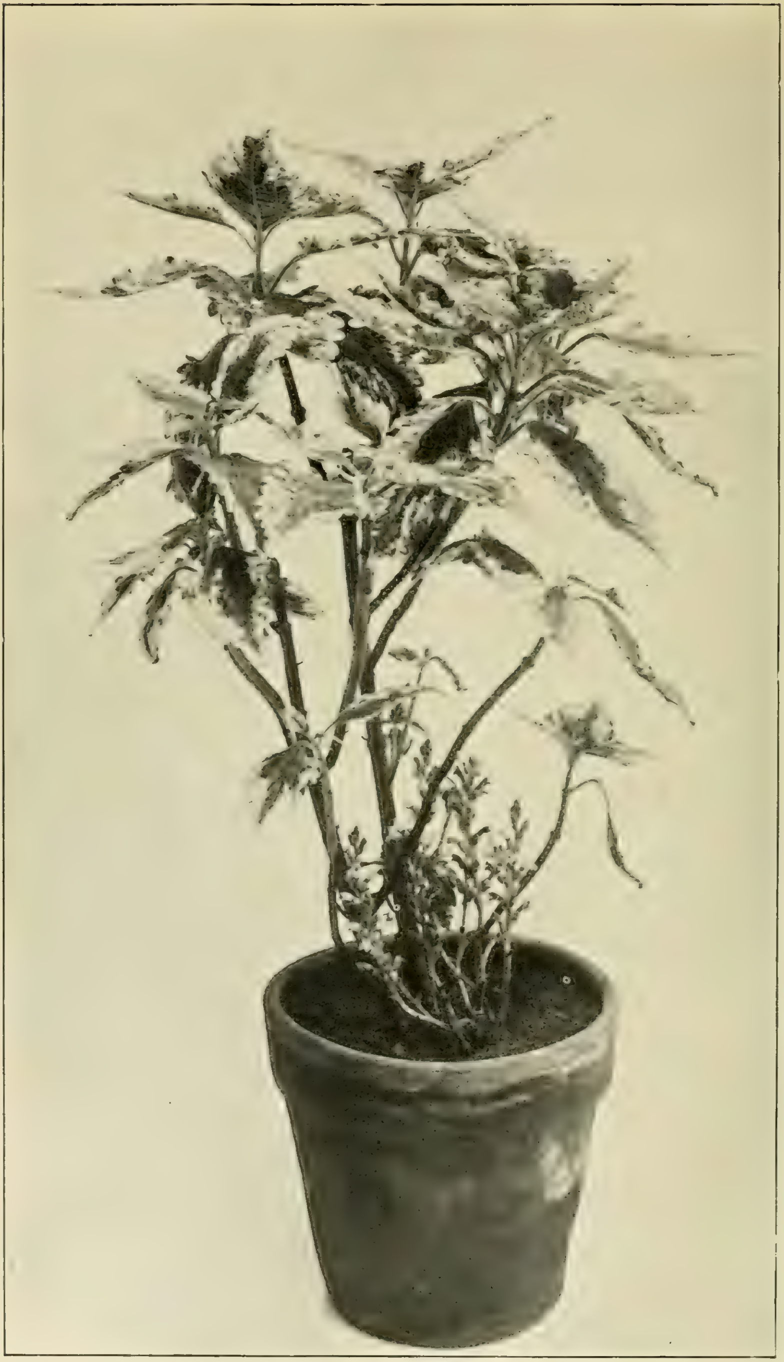

PLATE VII.

Coleus Plant in pot showing Broom-rape Parasite in Bloom near the soil.

experiments became infested with the species of broom-rape (*Orobanche ramosa* L.) that is sometimes quite destructive to the tobacco and hemp, particularly in Kentucky.*

Last year specimens were met with upon tomato,† which is a host closely related to the tobacco. In this instance the host is a member of the mint family and shows that this root parasite has quite a wide range of plants upon which it may possibly flourish. Plate VII. shows the potted coleus plant and the broom-rape that is growing upon it below the surface of the earth.

EXPERIMENTS IN GERMINATION OF CORN.

Thirty-two lots of corn were germinated with as little moisture in the soil as possible. Only lots Nos. 9, 10, 25 and 31 gave albinos. A duplicate set was grown in very moist earth, with the result that Nos. 9, 10, 22, 25 and 31 gave albinos. There was one albino plant in No. 22; otherwise, the numbers giving albinos were the same in the two lots. This would indicate that the albinism is in the seed or at least not induced by the amount of moisture in germination.

A considerable lot of small ears ("nubbins"), mostly immature, were placed upon moist moss and the scattered grains germinated. An albino seedling was a rare exception. This indicates that immaturity of the grains is not a condition for albinism.

Ears yielding albinos were selected and twenty grains from each row planted.

No. 1.			No. 2.			No. 3.			No. 4..		
Row.	Albinos.	Green.	Row.	Albinos.	Green.	Row.	Albinos.	Green.	Row.	Albinos	Green.
1...	1	19	1...	3	17	1...	1	19	1...	3	19
2...	2	16	2...	2	18	2...	2	18	2...	2	16
3...	..	19	3...	4	14	3...	..	20	3...	4	16
4...	5	14	4...	1	18	4...	4	16	4...	1	18
5...	2	18	5...	3	16	5...	2	18	5...	3	16
6...	..	18	6...	5	14	6...	..	20	6...	4	15

This indicates that the albinos are not confined to certain pairs of rows on the ear.

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* Bulletin 24, Kentucky Experiment Station, 1890.

† Report for 1901, p. 435.

Tests were made of grains from ears when there were three (triplets) upon the stalk:

			Albinos.	Green.
No.	1.	Oldest ear	..	20
"	2.	Middle "	..	20
"	3.	Youngest "	..	16
"	4.		1	14
"	5.		1	15
"	6.		..	1
"	7.		..	2
"	8.		..	18
"	9.		..	14
"	10.		..	20
"	11.		..	17
"	12.		..	17

Here there were only two albinos, and both from ears of the same plant. These were the oldest and the middle ear upon the stalk.

A larger test was made of grains from ears where there were two (twins) upon the stalk:

			Albinos.	Green.			Albinos.	Green.
No.	1.	Older	..	17	No.	1	3	9
"	2.	Younger	..	20	"	2	1	18
"	3.		7	12	"	3	..	13
"	4.		3	14	"	4	1	19
"	5.		..	20	"	5	1	18
"	6.		..	18	"	6	7	9
"	7.		..	17	"	7	2	18
"	8.		..	17	"	8	1	11
"	9.		2	16	"	9	..	20
"	10.		..	19	"	10	..	20
"	11.		..	14	"	11	..	18
"	12.		2	12	"	12	..	18
"	13.		..	7	"	13	4	14
"	14.		..	15	"	14	2	17
"	15.		..	16	"	15	..	20
"	16.		..	15	"	16	..	20
"	17.		..	19	"	17	..	19
"	18.		..	18	"	18	..	18
"	19.		..	18	"	19	..	20
"	20.		..	9	"	20	..	7

In the first set only four ears yield albinos, two of which are the older and two the younger ears upon the stalk. It is to be observed that the majority of all the white seedlings came from the second pair of twins (Nos. 3 and 4) where both ears gave albinos.

In the second set nine ears gave albinos, four being of the older and five of the younger ears. It is to be noted that in all instances but one where one ear of a pair showed albinism, the other also did the same. This indicates that the whole plant is affected.

Special test of prolific corn was made as follows, twenty grains in a planting from each year:

	Ear.	Albinos.	Green.
Plant 1.....	A	3	17
	B	2	16
	C	1	19
Plant 2.....	A	..	20
	B	..	18
	C	..	16
Plant 3.....	A	5	12
	B	2	16
	C	5	13
Plant 4.....	A	..	20
	B	..	19
	C	..	17
Plant 5.....	A	..	20
	B	..	20
	C	..	18
	D	..	17

	Ear.	Albinos.	Green.
Plant 6.....	A	..	20
	B	..	20
	C	..	20
Plant 7.....	A	3	16
	B	1	18
	C	..	19
Plant 8.....	A	1	19
	B	1	19
	C	1	19
Plant 9.....	A	1	19
	B	2	18
	C	7	13
	D	2	16
	E	3	17

In this test it is noted that when one ear of the set of three to five from a stalk showed albinism, the others did also, with but a single exception. Plants 2, 4, 5 and 6 gave no albinos. The oldest ears (A) gave 3, 5, 3, 1 and 1 white seedlings, respectively, or a total of 13. The next oldest gave 2, 2, 1, 1, 2, or a total of 8. The third ear gave 1, 5, 1 and 7, or 14. The single fourth ear gave 2 and the fifth ear 3 albinos.

The white seedlings do not seem to be attributed to over bearing of the stalk or to age of the ear when twins or triplets are produced.

Several tests were made of inbred corn in contract with wide-bred ears. The former received only the pollen of the same plant, while the latter has the tassels removed before the silks were receptive.

Inbred Corn.	Albinos.	Green.
No. 1	13	47
" 2	15	38
" 3	7	48

Wide-bred Corn.	Green.
No. 1	60
" 2	65
" 3	65

There were seventy grains planted at four different times from each of the six ears. Of the inbred corn over a quarter were albinos, while none appeared among the two hundred seedlings of the wide-bred grains.

Plate VIII. shows the plants in one of the tests when two weeks old. Rows 2 and 3 are particularly poor, as shown in contract with the plants in row 4. The albinos, although present, are not easily seen in the engraving.

The number of tests in all the above-mentioned germinations is too small to warrant any conclusion, but the results as a whole point towards close fertilization as the cause. It would be well for all growers of corn to detassel the plants from which the seed ears are afterwards selected.

ON THE BEHAVIOR OF MUTILATED SEEDLINGS.*

The particular form of mutilation of seedlings here considered is that of the removal of the plumule. Several kinds of plants have been tested during the last twelve months in the deplumuling of the young seedlings. The first of these was the garden radish, representing a small, large-rooted and short-lived plant. Soon after the seedling was above ground the pumule was removed upon alternate rows of plants, while the other rows were left to grow normally. The first thing to observe was the much deeper green of the cotyledons of the deplumuled plants. This was followed by a remarkable elongation of the petiole and the large size of the obcordate blade, the former attaining a length of three inches and the latter a breadth of an inch and a half. These cotyledons were raised at an angle of about 45°, and the very dark-green blade had a thickness nearly double that of the normal

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*Abstract of a paper prepared for the fifth meeting of the Society for Plant Morphology and Physiology, at Columbia University, January 1st, 1902, and published without illustrations in Torrey's February, 1902.

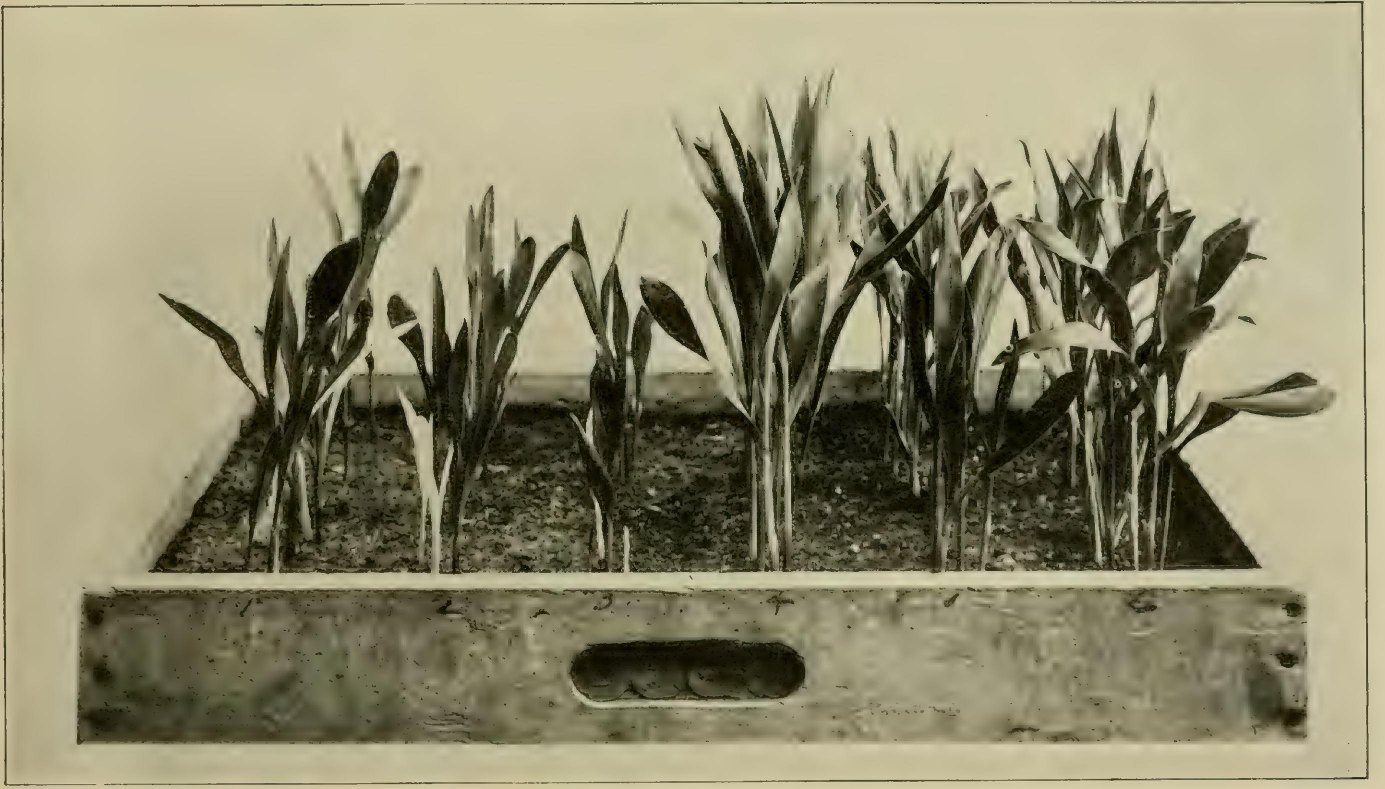

PLATE VIII.

Inbred and Wide-bred Corn. Rows *1, 2* and *3* are from Inbred grains; rows *4, 5* and *6* from Wide-bred grains.

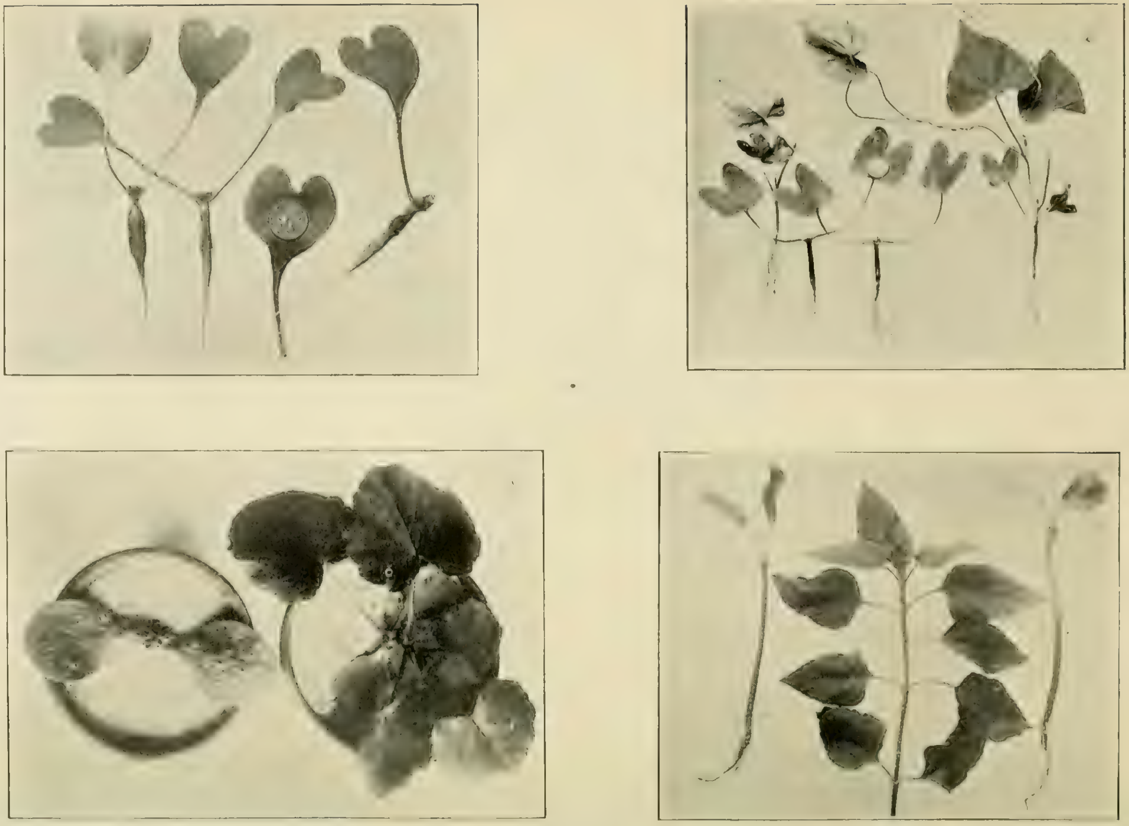

PLATE IX.

Mutilated Seedlings. *1*, Radishes with Bud Removed; *2*, Morning Glories with Bud Removed, one Normal; *3*, Squash Deplumuled *4*, Sunflower Deplumuled, one Normal cotyledons. A microscopic examination showed that the greater thickness was due to increased size of the cells instead of to a multiplication of the layers. The chlorophyll was excessive and the amount of starch so great as to practically render them black when blanched with alcohol and iodized. The roots grew to nearly market size, and had the tests been made with a turnip-shaped sort instead of a long variety, it is very likely that the roots would have been fit for the table. See 1, Plate IX.

The second species was the common morning-glory (*Ipomœa purpurea*). Here the cotyledons are large in the seedling, but quickly are lost from sight by the development of the much larger alternate true leaves. After holding on for a few days, as a rule, the cotyledons lose their green color and drop from the stem. In the deplumuled seedlings petioles at once begin to elongate, as was shown to be true with the radish, while the remarkable green develops in the blades, that likewise become double or more the normal size and become the organs of photo-synthesis from the mutilated plant. Their dark green is shared by the long, arched petioles (quite different in this respect from those of the radish) and the hypocotyle. The latter becomes of twice the sectional area of the normal plants, that are now several feet high and bearing flowers and become a store-house for the starch, that is robbed of its proper use by the absence of any stem. The root system of the deplumuled plant is not different from that of the normal specimens. See 2, Plate IX.

A third type of plant put to the test is the Hubbard squash, the seedlings of which naturally have large cotyledons. In these the seed leaves remain near the soil, without any apparent elongation of the hypocotyle, but there is a remarkable increase in the size of the cotyledons, until they are sometimes four or more inches in length and very odd, to say the least. Normally, the true leaves come forth from the pumule rapidly, and, due to their large size, the cotyledons are soon out of sight and quickly wither away. Dwarfed squash plants, depending entirely upon the cotyledons, have been kept in apparently healthy condition for four months, the size remaining practically the same after the first four weeks. These plants, unlike those previously mentioned, need frequent attention, for buds will develop in the axils of the seed leaves, which, when removed, will be followed by others without any determined number. If left undisturbed a whole thick cluster of stems and small leaves will develop. See 3, Plate IX.

The eggplant, as representing a slow-growing type of bushy plant, was employed for the tests in question, and it was found that they behaved in a manner similar to the radish, in that the petioles became ridged and nearly upright, and bore the thick, almost fleshy, much-enlarged oblanceolate blades well up in the air and sunshine. In this form the deplumuled plants will stand still, in a very liberal sense of that term, for an indefinite time—not weeks, but long months.

The last type of plant to be considered is represented here by the common sunflower (*Helianthus annuus* L.). As with the other types, the plants in alternate rows were deplumuled. The first change was quickly observed, namely, in the enlargement of the cotyledons, but here the most noticeable thing observed was the elongation of the hypocotyle, which finally reached fully nine inches or double that of the normal plants. There is a greater tendency for pypocotyledonary growth in the sunflower than any other of the types named, and this was remarkably accentuated in the mutilated plant. The structure of this stem, even at the end of three months, retained, generally, the primitive structure it possessed as a young seedling—that is, for example, the wood zone was made of a series of stout bundles, evenly disposed, without the filling in and completion of the thick ring of zylen, so well demonstrated in the normal plant at the same age. See 4, Plate IX.

The experiments illustrate how an organ normally designed to store food for the developing seedling may persist, in case of an emergency, and take on a greatly increased size for that purpose. The petiole may assume a direction in connection to its enlargement that will aid the blade in its work of photo-synthesis. Along with these changes in the seed leaves there may be others in surrounding parts, particularly the hypocotyle when it becomes thickened, remarkably, and green in the morning-glory and greatly elongated, but slender in the sunflower. In case of the radish, a place for any surplus growth is provided for in the root naturally destined to be fleshy, and the hypocotyle is not modified.

Perhaps the greatest surprise is the length of time a plant will hold out when it is deprived of the means for making a successful struggle for life and all possibility of reproduction.

FUNGICIDES AND SPRAYING.

The fungicides employed in the greenhouse during the past season were kerosene emulsion and soap, and, at the Experiment Area, soda-Bordeaux.

The constituents of the emulsion were in the following proportions:

Kerosene	2 pints.
Hard soap	2 ounces.
Water.	8 gallons.

This formula is the same as that frequently recommended as a greenhouse insecticide, with the exception that it calls for twice the quantity of water. To prepare, the requisite amount of "Ivory" soap was dissolved in about one gallon of boiling water, and, after removing from the fire, the kerosene was added. Drawing the solutions through a knapsack pump is a very satisfactory method of combining them. Ten minutes "pumping into itself" should produce a creamy mass that will not separate. After adding the proper amount of water the emulsion is ready for use. A considerable quantity of the concentrated emulsion may be set away in closed vessels and drawn out as needed.

The soap solution employed consisted of "Ivory" soap and water in the proportions called for by the emulsion formula, namely, two ounces of soap to eight gallons of water.

How Applied.—For testing different strengths of kerosene emulsion and soap upon a few potted plants, an atomizer was used; but for treating the larger number of plants in the bench, a knapsack pump was employed after the first two weeks. The atomizer is very convenient where only a pint or two is to be applied, but for larger amounts the knapsack pump is much more satisfactory, it applying the solution more thoroughly and in a much shorter time.

A—*In the Greenhouse.*—For testing the fungicidal values of kerosene emulsion and soap in the Station greenhouse, mildewed plants of *Phlox Drummondii* and the common verbena were employed. On November 8th mildewed seedlings of these were selected and transferred from the Experiment Area to the coolest benches in the greenhouse. They were disposed in twenty-one cross-rows, five plants to a row.

The disease thrived under the new conditions, and by the end of two weeks its presence upon the plants was very apparent. Spraying was begun November 27th, and between that date and April 1st twenty-six applications were made. During cloudy weather, when the conditions were most favorable to the mildew, the applications were made every two days.

For a time there was no striking contrast between the sprayed plants and the unsprayed; but after the third week the mildew was much more conspicuous upon the unsprayed. These made but feeble growth and developed almost no flowers. Before the end of the season two-thirds of the phlox plants were dead. The check verbenas survived, but were practically worthless.

The plants treated with kerosene emulsion, although not wholly free from mildew, were not sufficiently affected to prevent their making a vigorous growth, and in due time blooming freely until the end of the season. Plate X. shows a portion of the spraying experiment with phlox. The untreated rows are upon the right and treated rows upon the left.

About midwinter a verbena plant seriously affected by mildew was transplanted to a box and its foliage divided as nearly as possible by a board partition. One of these halves was sprayed every six days with kerosene emulsion, while the other was untreated. The appearance of the plant at the end of the season is shown in Plate XI.

The soap solution was applied throughout the season at the same intervals as the emulsion, and while its effect upon the mildew was apparent, the plants so treated were plainly inferior to those sprayed with emulsion.

A limited test was made of the fungicidal value of half and quarter-strength solutions of the greenhouse fungicides employed.

3 potted plants were sprayed with half-strength kerosene emulsion.
3 " " " " " quarter " " "
3 " " " " " half " " soap.
3 " " " " " quarter " " "

These plants were sprayed at the same intervals as those in the bench. The half and quarter-strength emulsion seemed to prevent the mildew about as well as the full-strength solution, but it is desired to make a more extended trial of the weaker solutions before advising their use.

Half and quarter-strength soaps checked the mildew but little; the plants so treated being severely infested.

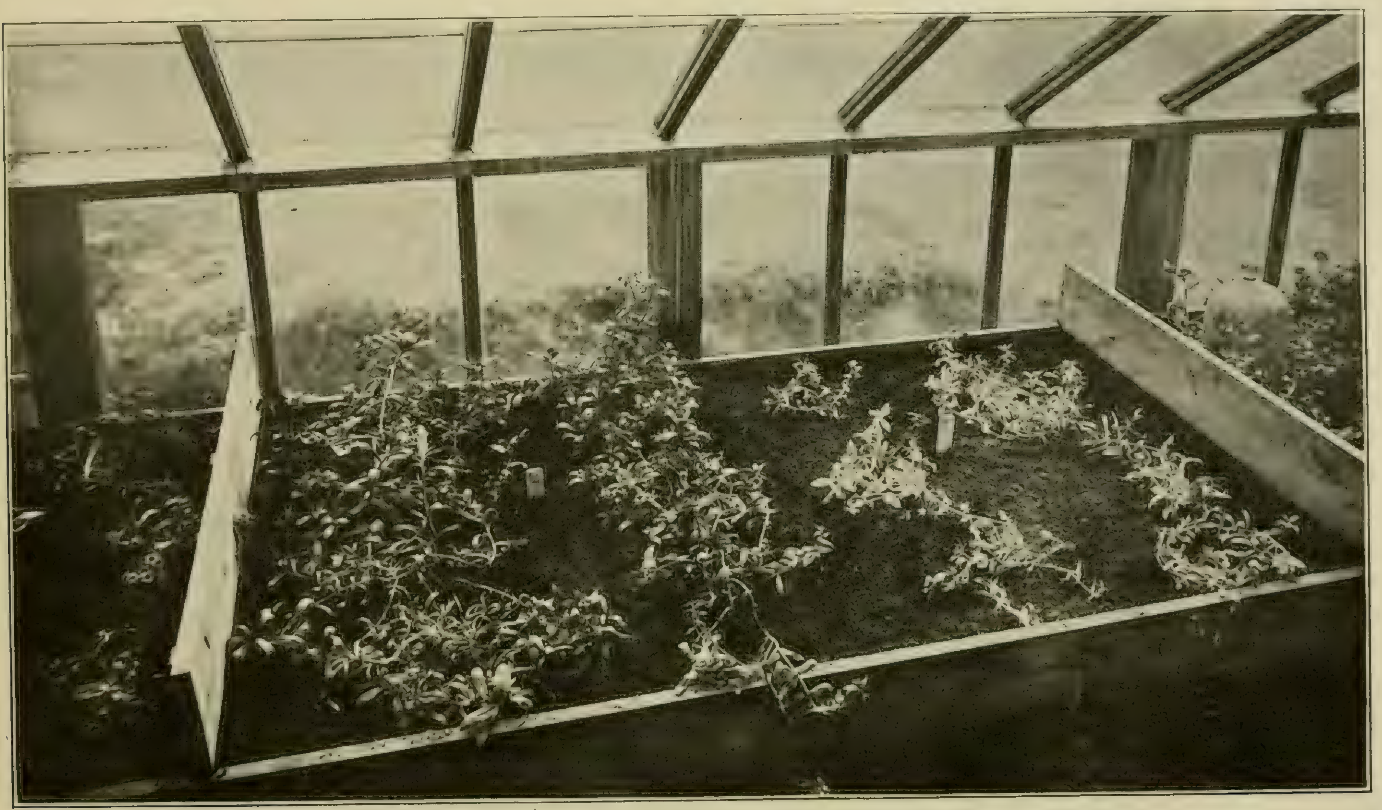

PLATE X

A portion of the Phlox bed showing the rows of Untreated Plants on the right, and the two Sprayed rows upon the left.

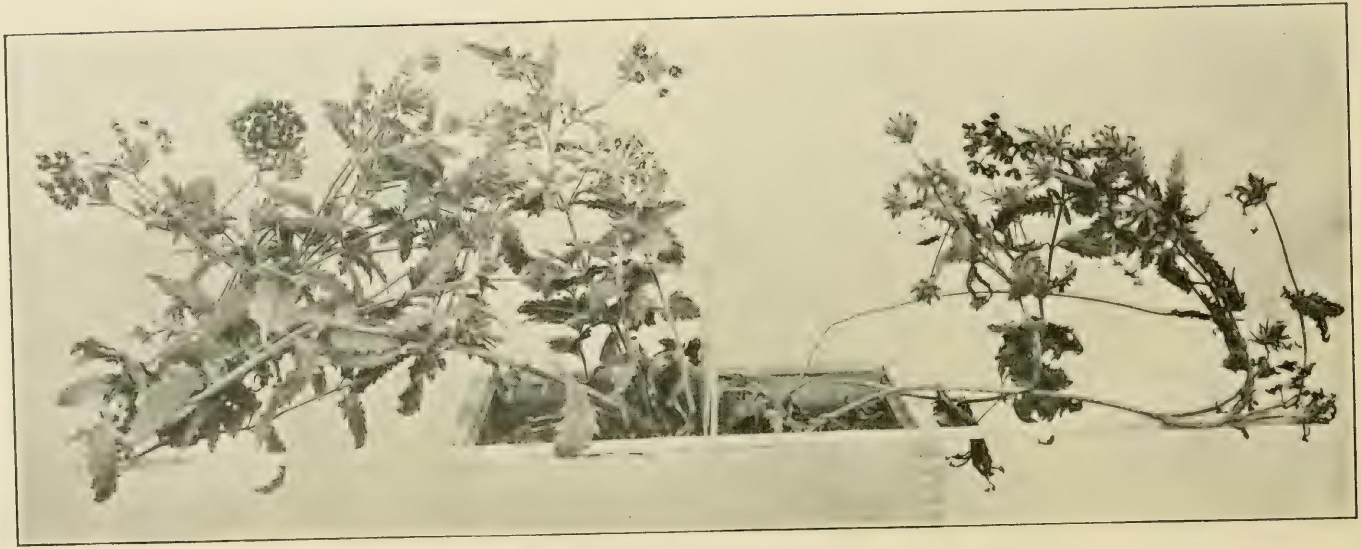

PLATE XI.

A Verbena Plant one-half (right) of which was left Unsprayed, while the other was treated with Kerosene Emulsion.

B—*In the Field.*—There was practically no spraying during the past summer at the Experiment Area. It was intended to spray with soda-Bordeaux two belts of bush beans, one belt of stock tomatoes, one belt of watermelons and all the crossed cucumbers.

The first application was made July 12th, the second July 23d, after which it seemed almost impossible to repeat the applications as frequently as conditions demanded without neglecting other duties. Spraying was therefore discontinued. No appreciable results followed the two applications.

FUNGI AS RELATED TO WEATHER.

The following items are gathered from the "Weather and Crop Bulletins" issued weekly by the State Weather Service during the months of April to September:

July 8th—"Tomatoes backward and showing some blight;" "Plums rotting;" "Apples dropping."

July 15th—"Blight or fungus has appeared on the apple trees, leaves becoming yellow and spotted;" "Tomatoes and potatoes blighting."

July 22d—"Less injury by insects and fungus."

July 29th—"Plums rotting on the trees."

August 5th—"Potatoes blighting and much affected by scab;" "Potatoes being blighted;" "Potato vines turning yellow and some rot showing;" "Plums rotting somewhat;" "Some blight appeared in tomatoes;" "Potato rot feared if present showery conditions continue;" "Asparagus rust spreading rapidly, both on old and new beds;" "Potatoes on low ground rotting;" "Apples dropping badly;" "Grapes doing well, very little rot;" "Sweet potatoes making too much vine;" "Potatoes a heavy crop, but rotting badly; "Grapes doing well, no rot;" "White potatoes rotting in low fields."

August 12th—"Early potatoes being dug, some fields badly rotted;" "A large crop of potatoes is being dug, some rot showing;" "Potatoes show indications of rot on wet land;" "Many tomato fields are affected by blight;" "Some potatoes rotting in low ground;" "Cantaloupes poor, vines scalding;" "Plums rotting on the trees."

August 19th—"Muskmelon vines have commenced to blight;" "Plums and peaches both rotting;" "Only one case of rot in potatoes heard from, and that is in low, damp ground;" "Some rot in potatoes on wet ground;" "Potatoes show signs of rot;" "Some peaches rotted;"

"Asparagus rusting;" "Late tomatoes blighting;" "Many peaches have rotted on the trees;" "Peaches a light crop, early varieties cracking and rotting owing to excessive rains;" "Peaches, good crop, but frequent rains have caused much rotting;" "Corn in low fields scalding;" "White potatoes rotting in low fields."

August 26th—"Some potato rot;" "Potato crop heaviest in several years, but rotting in low ground;" "Peaches and plums rotting on the trees;" "Grapes out of danger from rot."

September 2d—"Potatoes rotting in places;" "Potatoes a large yield, but rotting;" "About one-third of the potatoes have rotted."

September 9th—"Potatoes in many places are rotting badly;" "Heaviest and finest yield of potatoes for years, no rot;" "Tomato blight severe, fruit dropping from the vines."

September 16th—"Potatoes all dug, some rot."

Temperature and Rainfall Since 1889.

The following table shows the temperature, in degrees (F.), and rainfall, in inches, for the present year, and the average for the past thirteen years since the Station was established:

	Temperature.		Rainfall.	
Month.	1902.	Average 13 years.	1902.	Average 13 years.
January	28.4	29.9	3.28	3.66
February	27.4	31.4	6.24	4.05
March	43.9	38.4	4.34	3.89
April	50.2	49.1	3.62	3.42
May	60.3	60.6	2.04	4.50
June	67.5	69.7	6.57	3 54
July	73.0	74.0	4.78	4.96
August	70.1	72.5	3.91	4.21
September	64.6	66.3	5.65	3.68
October	56.0	53.9	6.39	3.68
November	49.3	43.5	2.20	3.99
December	31.7	34.3	7.23	3.39

In temperature, 1902 had a cold January and February, with a warm March, April and May, an average and cool June and August, with July somewhat below the normal. There was an excess of moisture in February and June, with a small rainfall in May and less than the average in July and August.

NOTES UPON SOME RUSTS AND MILDEWS AT WERNERSVILLE, PA.

While sojourning for health at Wernersville, Pennsylvania, during several weeks in the spring, some observations were made upon the parasitic fungi of that region.

Rusts.—Among the first of the rusts to appear was an *Aecidium* upon *Ranunculus abortivus.* This host is very common in the open woods, and the rusted plant is easily detected by the small, spade-shaped leaves, that stand up edgewise upon long, slender petioles. The diseased plants last for only a week or so after the cluster cups appear, thickly covering the under side of each leaf. The fungus seems to destroy all the portion of the plant above ground, and while, during one week, the display of rust is extensive, at the end of the next there is little left excepting dead leaves.

There were some small quince orchards in the region, and one in particular was bordered upon two sides by a hillside covered with cedar trees. In some instances the branches of the quince trees and those of the cedars interlocked. The cedars bore an abundance of the large, yellow galls commonly known as "cedar apples." These are the conspicuous formations of the rust fungus known as *Gymnosporangium macropus,* and in another form does much damage to the apple leaves and fruit. Upon the same cedar trees was an abundance of another species of *Gymosporangium* (*G. globosum*). This does not produce spherical galls like the one first mentioned, but causes a swelling of the small branches until they are somewhat spindle-formed, and become covered with an orange coating at the time when spores are set free. Upon the quince leaves, before they were full-sized, the rust appeared in considerable quantity, sometimes occupying all of the under surface when the numerous clusters of deep cups were produced. Later on the fruits probably became infested, for the mummy fruit of the previous year showed that the fungus had destroyed them. This *Roestelia aurantiaca,* as the orange rust of the quince is sometimes called, botanically, might be reduced by separating the two host plants of the fungus by cutting away the cedars near the orchards or exercising care in setting quince trees apart from the cedars.

The ash trees showed conspicuously the rust (*Aecidium Fraxini*) that is common to the species of *Fraxinus.* In the present instance some ash trees were entirely free, while others of the same species had their leaves badly infested. This fungus works upon the leaf stalk in particular and causes it to twist into all sorts of fantastic shapes.

Wild roses, in some places, were so badly infested with a rust (*Phragmidium subcorticum*) that they were practically destroyed. This fungus, of an orange color, attacks the canes, as well as the leaves, and distorts and dwarfs them. This fungus was found in patches upon the untilled hillsides, while in other places the rose-bushes were free from it and healthy.

Among the herbs infested with a rust may be mentioned the sweet cicely (*Osmorrhiza brevistyles*), which is usually more or less affected with the *Puccinia Pimpinillæ* Strauss.

Mildews.—The *Peronospora Ficariæ* Tul., upon *Ranunculus recurvatus,* was quite abundant early in the season. Other hosts for same mildew were *Ranunculus abortivus* and *R. repens,* but it was most conspicuous upon the first-named crowfoot.

A chickweed (*Cerastium longipedunculatum*) was abundant in that region and badly infested with *Peronospora alsinearum* Casp. The mildewed plant usually remained small and produced no flowers. In some patches all the plants were diseased and dwarfed.

The tall figwort (*Scrophularia Marylandica* L.) showed the most conspicuous mildew, its large leaves being much discolored and sometimes distorted by the *Peronospora sordida* Berk. This is one of the mildews that produces a decidedly violet coating upon the infested part of the leaf, and, also, the border of the mildewed spot has a distinct purple border, as seen from the upper side. Some of the young plants were so badly infested as to be ruined.

The galiums were badly mildewed with *Peronospora calotheca* DeBy. It was most common upon the upright *Galium* Sp., where the whole plant was dwarfed and rendered of a pale color.

Many other fungi were met with, of which only one may be added here, namely, a smut upon Actea or Baneberry. This *Urocystis* infests the whole plant, from the base of the stem to the divisions of the large, compound leaf.

A large number of specimens of these various parasite fungi were secured for further study and distribution.

FUNGOUS ENEMIES OF PLANTS IN NOVA SCOTIA.

A trip was made into Nova Scotia for personal health. Five places were visited, namely, Halifax, Wolfville, Kentville, Digby and Yarmouth. Wolfville and Kentville are in the region of extensive fruit-growing, and particularly the orchard, crops. This is the home of the Gravenstein apple. Plums are grown quite extensively.

The following are some notes made upon the prevailing fungi infesting crop plants:

Apple—
Anthracnose of fruit or ripe rot (*Glœosporium fructigenum* Berk.).
Scab (*Fusicladium dendriticum* (Wallr.) Fckl = *Venturia inæqualis* (Cke) Ad.).
Barley—
Smut (*Ustilago Hordei* (P.) Kell. & Sw., and *U. nuda* (Jens.) Kell & Sw.).
Bean—
Anthracnose (*Colletotrichum Lindemuthianum* (Sacc. & Magn.) Bri & Cav.).
Beet—
Leaf-Blight (*Cercospora beticola* Sacc.).
Backberry—
Leaf-Spot (*Septoria Rubi* Westd.).
Rust (*Cæoma* (*Uredo*) *luminatum* Lk.; Syn. *Puccinia Peckiana* Hwe).
Catalpa—
Leaf-Spot (*Phyllosticta Catalpæ* Ell. & Mart.).
Cherry—
Black Knot (*Plowrightia morbosa* (Schw.) Sacc.).
Fruit-Mold (*Sclerotinia cinerea* (Bon.) Schrt.).
Leaf-Spot (*Cylindrosporium Padi* Karst. = *Septoria cerasina* Pk.).
Clover—
Leaf-Spot (*Phyllachora Trifolii* (P.) Fckl.).
Rust (*Uromyces Trifolii* (A. & S.) Wint.).
Currant—
Anthracnose (*Glœosporium Ribis* (Lib.) Mont. & Desm.).
Hollyhock—
Rust (*Puccinia Malvacearum* Mont).
Horse-Chestnut—
Leaf-Spot (*Phyllosticta sphæropsoidea* Ell. & Ev.).
Maple—
Leaf-Spot (*Phyllosticta acericola* Cke. & Ell.).
Oats—
Rust (*Puccinia coronata* Cda, and *P. Graminis* P.).
Smut (*Ustilago Avenæ* (P.) Jens, and *U. Levis* Kell. & Sw.) Magn).
Peach—
Leaf-Blight or Shot-hole (*Cercospora Persica* Sacc.).
Leaf-Curl (*Exoascus deformans* (Berk) Fckl.).
Scab (*Cladosporium carpophilum* Thum.).

Plum—
    Black Knot (*Plowrightia morbosa* (Schw.) Sacc)
Potato—
    Leaf Mold or Early Blight (*Alternaria Solani* (E. & M.) Jones & Grout).
    Scab (*Oospora scabies* Thaxter).
Quince—
    Rust (*Gymnosporangium* sp., Syn. *Ræstelia* sp).
Rose—
    Rust (*Phragmidium subcorticium* (Schrank) Wint., and *Ph. speciosum* Fr.).
Rye—
    Smut (*Urocystis occulta* (Wallr) Rabh.).
Strawberry—
    Leaf-Spot (*Sphærella Fragariæ* (Tul.) Sacc.).
Tomato—
    Leaf-Spot (*Septoria* sp.).
Violet—
    Leat-Blight (*Cercospora Violæ* Sacc.).

Many specimens of nearly all the above species of economic fungi were collected, together with a large number of those upon weeds and wild plants. After further study these will be ready for distribution among the various centres of mycological investigation.

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REPORT OF THE BOTANIST.

REPORT OF THE BOTANIST.

BYRON D. HALSTED, SC.D.
JAMES A. KELSEY, M.SC., FIELD ASSISTANT.

The work in the Botanical Department for the year ending November 30th, 1903, has been chiefly along lines mentioned in the reports for the past few years.

Plant breeding has been a leading feature of the work in the field, supplemented by that of the greenhouse. During the year a new variety of sweet corn has been established, which resulted from crossing the "Black Mexican" upon the "Egyptian." This combination has produced a variety with good-sized plants, and ears of satisfactory size and number of rows of graining upon the cob. The color of the green corn when ready for market is a rich pink, and therefore especially attractive. Progress has also been made in developing a variety of corn that may have the grains mixed in the ear—pink and white—and with a special tendency to produce more than two ears to each plant. During the season a cross has been secured between the "Black Mexican" and the "Country Gentleman" for future development by selection.

The crosses between eggplants, effected some seasons ago, have developed into one sort that seems reasonably fixed. During the present year crosses have been made between three Japanese varieties and some of our own standard sorts.

Among lima beans, the work of selection and fixing the peculiarities of certain crosses is going on. In this connection a test was made of the standard sorts that brings out important facts, particularly concerning susceptibility to the mildew, which was unusually abundant the present season.

Considerable of the Experiment Area was devoted to tomatoes, and at least one new sort is developed, namely, a yellow kind, that combines the qualities of two standard varieties and with tendencies that suggest it as a good breeder for further desirable points. The work of reducing the seeding tendency is going forward, with hope of success in that direction.

The stability of the hybrid salsifies is being tested and new hybrids are each year being secured for a study of their economic value.

The several plots of corn gave an opportunity of growing and obtaining crosses between a number of varieties of squashes. No immediate effect of foreign pollen was observed, and no crosses, after many trials, were secured between the winter and summer varieties.

Considerable attention was given to hybridizing daturas, both in the greenhouse and the field. The weedy species seem to impress their characters upon the hybrids almost to the exclusion of the parent representing the ornamental kind.

The Drummond phlox has been bred in the field and many types of the fringed flowers have been obtained, with colors ranging from pure white to dark red.

This phlox has proved to be one of the best subjects for the study of fungicides for mildew in the greenhouse.

The facilities for laboratory and herbarium work have been much curtailed by the fire in the Station building and the consequent removal to other quarters for a larger part of the present year. The usual number of specimens have been secured and will be installed when the collections are returned to their former places.

The subject of powdery mildews has been one for study from the standpoint of number, kinds, distribution and destructiveness in the United States.

On account of the exceptional weather and the unusual prevalence of decay in potatoes, tomatoes, etc., the ailments of these crops have commanded some attention in the present report, and tables of rainfall, temperature and sunshine have been constructed, covering the past fifteen years.

Observations have been made from time to time upon asparagus rust, and data accumulated by correspondence as to its spread throughout the United States.

Weeds have been unusually abundant this year, and some space is given to this subject in the body of the report.

Bulletin No. 167: "Some of the Newer Fungicides," of sixteen pages, and two page-plates, was published June 29th, 1903.

The details of the work, both at the greenhouse and in the Experiment Grounds, have been, as formerly, in charge of Mr. J. A. Kelsey, to whose faithfulness any success in breeding plants and other painstaking operations is largely due. Sickness on the part of the writer has prevented him from giving the usual amount of attention to the department.

The Experiment Area.

The plan upon the opposing page shows the method by which the Experiment Area of two acres has been divided and the location of the several crops that occupied the ground the present season.

The ends of the piece of land are brought to a rectangle with the long parallel sides, and then paths four feet wide, running the short way, cut the land into seven series. Each of these series is again divided by three two-foot paths, running the length of the area, thus making the twenty-eight plots, each 33 by 66 feet, and containing one-twentieth of an acre.

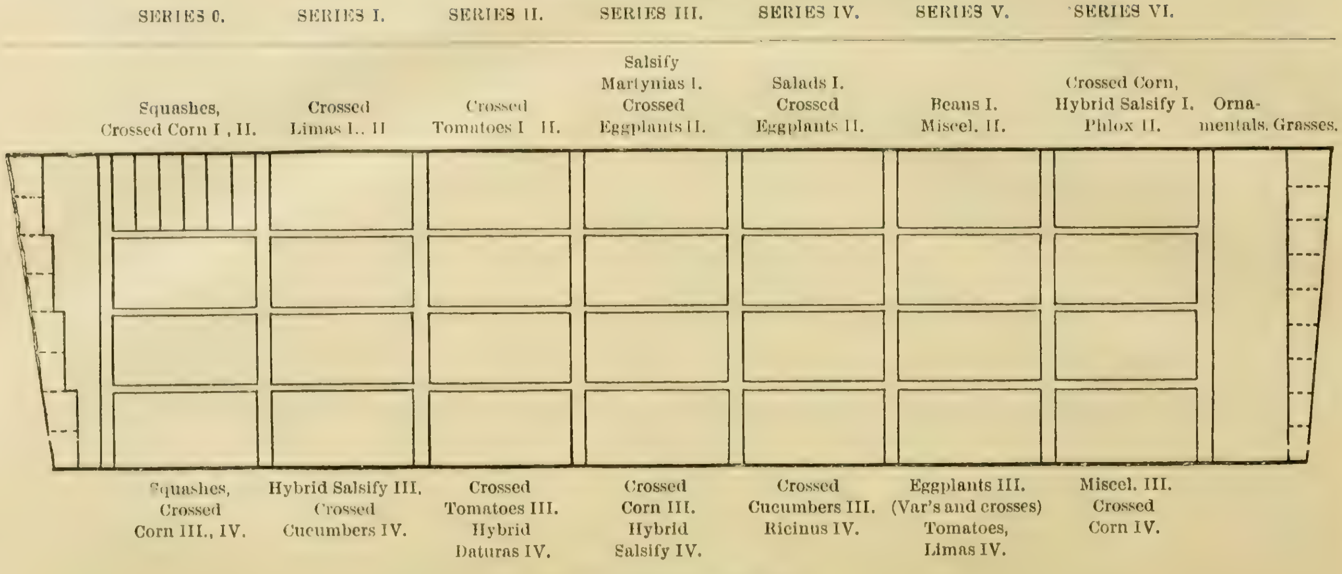
The soil is fairly uniform in quality throughout, it being a mixture of clay and gravel and not the best for garden purposes. Its texture has been improved by the application of stable manure at the rate of twenty tons per acre for the past nine years. During the last five years the manure has been placed in heaps of ten or twenty tons, and, when well rotted, added by measure to the several plots just before plowing or spading in the spring.

EXPERIMENTS WITH SWEET CORN.

The experiments in the crossing of sweet corn began in 1898, by planting the following sorts in the same plot: "First of All," "Stabler's Nonpareil," "Stowell's Evergreen," "Egyptian" and "Black Mexican." Cross-fertilization took place freely between the "Black Mexican" and the "Egyptian," some ears of the latter showing fully one-half of the grains of a dark color, indicating the effect of the former variety, the only one that was not white. It was observed that the dark color was less impressed upon the crossed grains of the "Stowell's Evergreen" than the "Egyptian." This suggested that the "Black Mexican" was more potent upon the "Egyptian" than upon the "Stowell's Evergreen," and led to the selection of the first two named sorts for future breeding.

In 1899 Plot II., Series III., was planted again to sweet corn,

The Experiment Area.


SERIES 0.
SERIES I.
SERIES II.
SERIES III.
SERIES IV.
SERIES V.
SERIES VI.
Squashes, Crossed Corn I., II.
Crossed Limas I., II
Crossed Tomatoes I II.
Salsify Martynias I. Crossed Eggplants II.
Salads I. Crossed Eggplants II.
Beans I. Miscel. II.
Crossed Corn, Hybrid Salsify I. Phlox II.
Ornamentals.
Grasses.
Squashes, Crossed Corn III., IV.
Hybrid Salsify III. Crossed Cucumbers IV.
Crossed Tomatoes III. Hybrid Daturas IV.
Crossed Corn III. Hybrid Salsify IV.
Crossed Cucumbers III. Ricinus IV.
Eggplants III. (Var's and crosses) Tomatoes, Limas IV.
Miscel. III. Crossed Corn IV.

The Experiment Area for 1903.

there being a row each of the "Black Mexican" and "Egyptian" in each of the six belts. The "Black Mexican" is a variety of medium stature of plant, and also medium in time of maturing, with eight-rowed ears and grain of good quality, but sometimes objected to because of the dark color. The "Egyptian" is a larger sort, with heavier ears and white grains, in ten to sixteen rows, maturing comparatively late, and of high quality.

During this first season of the cross not more than one grain in fifteen of the "Mexican" showed the influence of the "Egyptian." Five of the most affected ears gave a total of 1,093 black grains to 299 of white ones. There was more of the mixing upon the "Egyptian," as a corresponding five ears show black grains, 1,083, and white, 1,385. A comparison of the two sets of figures also shows the relative size of the ears of the two sorts. With the "Egyptian" crosses there were all gradations between the slightly purplish grains and those that were nearly as dark as those of the typical "Mexican," and many were of a rose or pale-red color. Occasionally a grain was found with one-half white and the other dark, and in a few cases the division line was along the narrow way of the grain and suggesting a birth-mark, covering one side of the face.

Experiments in 1900.

During the season of 1900 four plots were in sweet corn as a continuation of the crossing of the previous year. Plot IV., Series IV., was planted with pink grains from single ear of the "Egyptian" type. The good qualities of the two varieties under consideration stood in favor of the "Egyptian." For example: a ten or twelve-rowed variety is preferred to one with only eight rows, and for this and other reasons the above choice in the cross was made. This plot made a fine showing of strong corn plants, and from the ninety-six hills, 355 good ears were gathered, there often being two ears to the best stalks, and sometimes three or four. The ears were, without exception, remarkably uniform in the even mixing of the white and colored grains. Five average ears gave an average of 172 white grains to 213 that were colored. There is a blending of the two parent varieties in the shape of ear, number of rows, as well as in a large percentage of pink grains. The slender "Mexican" type is not fully maintained in even the few eight-rowed ears, the cob being larger, with the basal end somewhat swollen. The number of twelve-rowed ears exceeded all others, numbers which ranged from eight to sixteen showing that the mother plant ("Egyptian") had a very decided influence.

Experiments in 1901.

Plot IV., Series VI., was again planted to sweet corn, and the seed used was the pink grains from eight ears of the previous crop, and all having over ten rows upon the cob. The plants thus produced were remarkable for their vigor and size. At harvest time the first things observed was the greatly increased amount of red in the ears. The average of five typical ears gave 90 white, 81 black and 261 red grains. The number of grains per ear had increased considerably over the previous year, a feature of no small consequence when many rows is an advantage in sweet corn.

A greater variation in the ears was observed. In 1900 the ears were practically alike, but this season they ranged all the way from those with about half white grains to those in which the color was entirely red. It was also noted that nearly all the ears were more than eight-rowed, and this characteristic of the "Mexican" variety is largely lost from sight.

Experiments in 1902.

For the third successive season Plot IV., Series VI., was planted to sweet corn. From the previous crop a fine, solid-red, ten-rowed ear was selected and marked "X" ("Extra") at the time of harvest. For this some grains were taken, and a dozen plants grown in the greenhouse during the winter of 1901–2. Several ears were thus produced, all short, however, because of the unfavorable conditions for the best growth of corn, and from these, which were solid red, seed was selected for one-third of the plot, namely, belts 1 and 2. The remaining two-thirds of the plot was planted with grains from the ear marked "X"—that is, the mother ear of the greenhouse corn above mentioned. In other words, the whole plot was planted with the product of the same year; only the first two belts bore plants one generation further from the original cross of "Black Mexican" and "Egyptian." The greenhouse-grown seed produced smaller plants than in the other portion of the plot, a difference to be attributed to

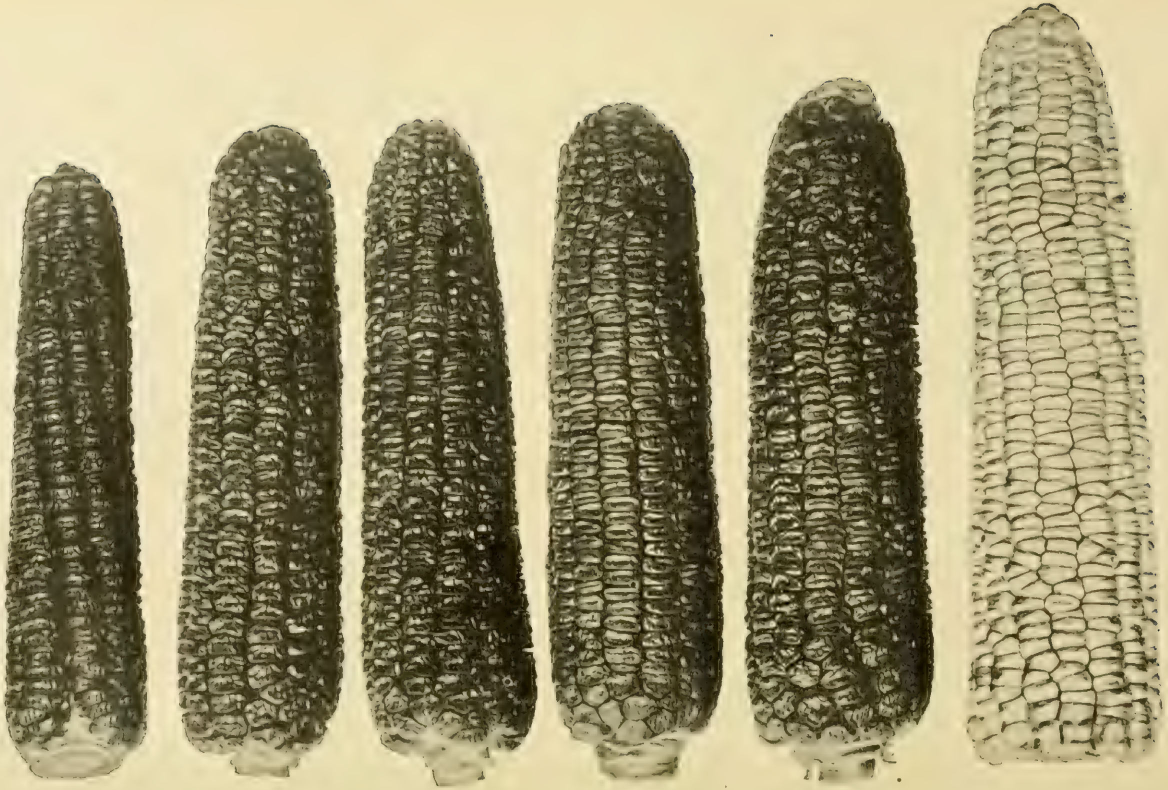


PLATE I.

Four ears of Voorhees Red Sweet Corn, with ear of male parent, "Black Mexican," upon the left, and an ear of the mother plant, "Egyptian," upon their right.

the poor conditions under which the seed was produced under glass. The ears, however, were not far below normal size.

At harvest time the first thing to be observed was the very large number of red grains, the average of five typical ears from the greenhouse seed being: white, 14; black, 0, and red, 373 grains; and of the same number of similar ears directly from the ear "X," white, 28; black, 0; red, 465. These figures show that the greenhouse grains produced less white kernels and somewhat smaller ears than the grain directly from ear "X."

It is seen that only a small percentage of white grains remains in this crop, which is from the planting of pink grains of a single ear of the "Egyptian" type in 1900.

The following table gives the number of rows for the best ears in the two portions of the plot.

	Greenhouse Progeny.	Direct from Ear "X."
No. of 8-rowed ears	3	6
" " 10 " "	10	15
" " 12 " "	42	38
" " 14 " "	15	14
" " 16 " "	6	6
Total	76	79

A little more than half (80 in 155) of these ears have twelve rows, and this is a number that is satisfactory in sweet corn.

Experiments in 1903.

For the fourth year in succession Series 0 was planted to corn, each of the four plots receiving grains from separate selected solid red ears of the previous crop. The season was unusually unfavorable for corn, it being exceedingly dry at the proper planting time and throughout May, to be succeeded by heavy rains in June and August, with winds that prostrated plants time and time again before harvest time. The yield was necessarily light, but from the size of the stalks and ears it was evident that under ordinary circumstances the crop would have been satisfactory. The number of solid red ears was very large, and seed has been selected from the best of these for future planting. Four sample ears are shown in Plate I., and upon the left is shown an ear of the male parent, "Black Mexican," and upon the right, a corresponding ear of the female parent, the "Egyptian." The former is black and the latter white, and the resulting cross red; the former is eight-rowed and the latter ten to fourteen, with which the cross agree in this respect.

The Director of the Experiment Station has kindly consented to the use of his name in connection with this new variety, and therefore it will be known as the "Voorhees Red Sweet Corn."

Developing a Prolific Corn.

In 1901 a half of Plot III., Series IV., was planted somewhat late (June 28th), with grains taken from seven ears borne by three stalks of the cross-breed of the previous year. One of the stalks had three fine ears, while the other four of the seven ears were first-grade twins. The triplet had two ears with ten rows of grains and one ear with fourteen rows. One twin had eight and ten rows to the ear, respectively, while the other pair were both twelve-rowed. These ears were all quite uniform in the ratio of white to dark grains—that is, as 4 to 5.

The forty-eight hills from this seed, planted without regard to color, yielded forty-four stalks with single ears, unusually large and invariably with ten or more rows; eighty-three stalks with two marketable ears, each with rarely less than ten rows, and seventeen stalks with three or more ears, among which was one with five ears, all over five inches long; one with six and one with seven ears, but of these only one or two were marketable. The total number of ears was 272, or nearly an average of two ears to each stalk, exclusive of many abortive attempts to produce more.

It is noted that the mixed red and white result is still maintained, but it is not as uniform for all the ears as in the previous year, as shown in the other engraving of the same plate. In 1901, in other words, some stalks show more white than others. The average number of rows of grains to the ear is ten, which is practically the same as for the ears from which the seed was taken for planting.

In 1902 a whole plot was given to a further study of prolific corn. Single-eared stalks were rarely met with, the main portion having either two or three ears. It is observed that the mixture of white and red grains is maintained, but some variation in ration among the four lots of ears. When a stalk bears more than three ears it is at a loss of commercial value of the product. There is difficulty in selecting seed for future planting, as there is a possibility of developing the tendency to produce ears beyond the limit of most profitable output of marketable ears.

During the present year Plot III., Series IV., was planted with "prolific corn," and the crop would have proved more satisfactory but for the very poor season. As it was, the late planting and heavy rains and windstorms gave a poor yield. There was a large percentage of stalks with two marketable ears, although many of them were small. There were strong indications of prolificness in stalks that had set three, four and even five ears, but usually they did not mature.

The ears at harvest showed a very even mixture of the white and pink grains, and by planting half of each of the two colors it may be possible to continue this mixture until it become a characteristic, so long as one or the other color is discarded in planting.

Crossing Corn—New Series.

Upon a half of Plot I. and the whole of Plot IV., Series VI., corn was again grown, but this time it was the beginning of a new series of crosses. The two varieties selected were the "Black Mexican" and the "Country Gentleman." The former has been used in the crosses with the "Egyptian," which gave rise, aided by selection, to the red sort that has taken the name of "Voorhees." It is, as often before stated, a black-grained variety, medium in size of plant and time for maturing, and with eight rows to the ear. It is of high quality and would be much more grown for the table were not its dark color an objection. The "Country Gentleman" is a white-grained sort, somewhat larger in plant and ear than the "Mexican," about two weeks longer in coming into bloom, and there are no well-defined rows, the numerous, long, pointed variable grains of high quality being very irregularly disposed upon the large cob.

In order to bring these two quite widely different varieties together and accommodate them as to time of blooming, they were planted in alternate rows, three rows apart, and after two weeks another similar planting, while the third planting, four weeks after the first, completed the plots.

The two sorts are easily distinguished as standing in the field, and one of the constant characteristics of the "Country Gentleman" was the handsome pink color of the silk, it being the white sort, while the "Black Mexican" had usually a pale green silk, although this is not constant, and some of the stalks bore pink silks—a variation that has been constantly met with in this variety.

There is little else to dwell upon for the present, except to show average ears of the parents and those in which the crossed grains are apparent from the mixture of the colors.

Plate II. shows a set of ears of corn that represent the "Black Mexican," upon the left, and the "Country Gentleman," upon the right. The next ear upon the left is a "Black Mexican," with a few grains only that have resulted from pollination of the "Country Gentleman," and the ear next to the right shows a larger percentage of this crossing. The right of the two middle ears is a "Country Gentleman" that resulted from hand pollination, and all its grains show the dark color that this crossing with the "Black Mexican" produced. To the right of the last-named ear is one which shows the mixing that was quite general in nearly all the ears of this sort.

The "Black Mexican" is an eight-rowed variety, but it sometimes happens that this number is somewhat increased, as instanced in ear that is next to one of the "Country Gentleman." The ordinary ear, when broken, appears as shown in the plate. The much longer and narrower grains of the "Country Gentleman" are similarly shown. This latter sort has pearly white grains that are disposed without apparent order upon the cob—that is, there are no distinct rows. It produces a larger ear than the "Black Mexican," and the ear required, in this experiment, fully two weeks more for it to reach marketable size. This was a very unusual season, and any tests as to periods of growth are not conclusive. With us the planting was much delayed on account of bad weather, and later on heavy floods and very destructive winds nearly ruined the experiment. This accounts for the comparatively small ears that appear in the picture. The unusual season may account for a fact that was painfully apparent at harvest time, namely, that but very few of the "Black Mexican" ears showed any white grains due to the pollen of the "Country Gentleman," while, on the other hand, it was almost impossible to find an ear of the latter sort that did not have dark grains due to the pollen of the "Black Mexican," all of which prevented the

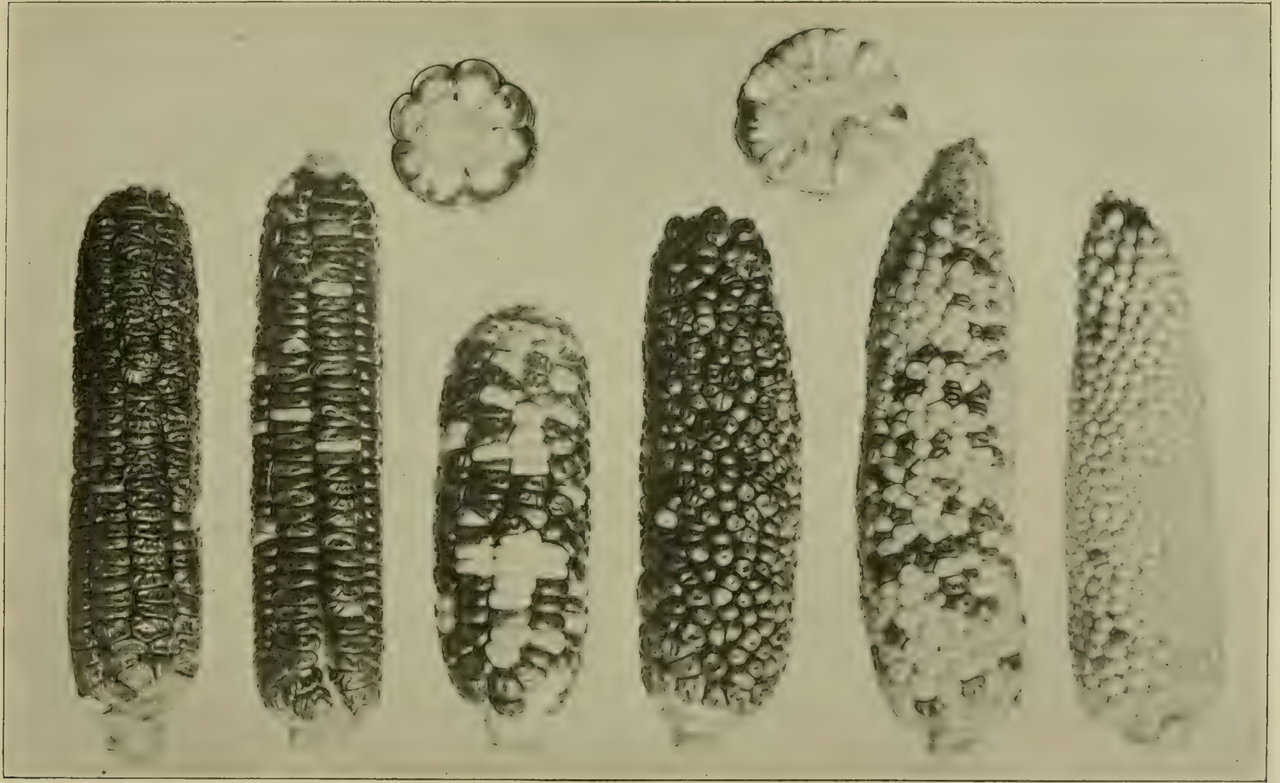


PLATE II.

An ear of "Black Mexican" Corn shown upon the left, and one of "Country Gentleman" upon the right, with two ears of each variety between, showing crossing of the two varieties.

ears in the plate from being up to the average of the meagre crop. As the matter now stands, the "Country Gentleman" is easily fertilized by the "Black Mexican," while the latter is with rare instances crossed upon by the "Country Gentleman." In other words, the "Black Mexican" is highly prepotent, as determined in other experiments. It was observed that the dark grains of the "Country Gentleman" were not usually of the same shade as the full "Black Mexican," but instead inclined to a lead color. The white grains upon the "Black Mexican" were, with few exceptions, as light as those of the full "Country Gentleman."

The quality of the two varieties is superior, as determined by actual test by those who are able to judge of the culinary merits of this vegetable.

Further Observations Upon Salsify Hybrids.

The salsify to which the most attention was given the past season was that in Plot IV., Series III., consisting of hybrids of *Tragopogon porrifolius* L. and *T. pratensis* L. Twenty-one rows were planted here in August, 1902, the seed for the first eight being from first-generation crosses produced that season in Plot III., Series IV., while that for the remaining thirteen was produced by third-generation hybrids in Plot I., Series VI. Rows 1 and 2 were offspring of hybrids that appeared in rows of *T. pratensis,* while the hybrid parents of rows 3 to 8 were developed among plants of *T. porrifolius.* The seed planted in rows 9 to 21 was gathered from second-generation hybrids in Plot I., Series VI., and represented the following colors of Prang's list: 21, 22, 31, 41, 92, 224, 225, 233, 243, 333, 355 and 384.

The stand of plants was fairly good, and the season's color record, including about 700 plants, is herewith given. Rows 1 and 2:

Parent type	93	Yellow	18
	234	Light red violet	1
	243	Red red violet	9
	243	" " " (center yellow)	10
	243	" " " (center mottled)	3

There was one "Albino" plant and one with flower heads changed to green.

Rows 3 to 8:

Parent type	93	Yellow	12
Parent type	224	Light violet red violet	2
	225	Lighter “ “ “	2
	233	Red violet	1
	234	Light red violet	12
	234	“ “ “ (center mottled)	7
	235	Lighter red violet	2
	235	“ “ “ (center mottled)	1
	242	Dark red red violet	2
	242	“ “ “ “ (center mottled)	1
	243	Red red violet	12
	243	“ “ “ (center mottled)	14
	253	Orange gray (brown) (center yellow)	1
	333	Red gray (russet)	4
	333	“ “ “ (center mottled)	1
	335	Lighter red gray (russet)	1

There was one “Albino.”

Rows 9 to 21:

	21	Darker red red orange (center yellow)	1
	21	“ “ “ “ (center mottled)	5
	22	Dark red red orange (center yellow)	1
	31	Darker red orange	7
	31	“ “ “ (center yellow)	21
	41	Darker orange red orange	3
	41	“ “ “ “ (center yellow)	1
	41	“ “ “ “ (center mottled)	1
	61	Darker orange yellow orange	1
	61	“ “ “ “ (center yellow)	1
	61	“ “ “ “ (center 243)	1
	82	Dark yellow yellow orange	1
	92	Dark yellow	1
Parent type	93	Yellow	98
	95	Lighter yellow	2
Parent type	224	Light violet red violet	6
	225	Lighter “ “ “	19
	233	Red violet	14
	234	Light red violet	120
	234	“ “ “ (center yellow)	6
	234	“ “ “ (center mottled)	6
	234	“ “ “ (center light)	43
	243	Red red violet	39
	243	“ “ “ (center violet)	46
	243	“ “ “ (center mottled)	28
	244	Light red red violet	1
	244	“ “ “ “ (center yellow)	1
	253	Orange gray (brown)	4
	254	“ “ “ (center yellow)	5
	325	Lighter violet red violet	1
	333	“ “ “ “	12
	333	“ “ “ “ (center yellow)	19
	333	“ “ “ “ (center mottled)	2
	334	Light red violet	3
	334	“ “ “ (center yellow)	22
	335	Lighter red gray (russet)	1
	335	“ “ “ “ (center yellow)	3
	354	Light yellow gray (citrine)	4
	355	Lighter “ “ “	5

A mixture of seeds, representing the various colors in rows 9 to 21 was planted in Plot III., Series III.

No attempt was made to record the number of hybrid plants of different colors in Plot I., Series VI., but it can be said that all the colors recorded in the plot just considered were observed here, and as a whole there seemed to be no striking contrast between the two plots.

An attempt was made the past season to cross *T. pratensis* and *T porrofolius* with their hybrids, and also with Scorzonera or "black salisfy." The seeds from flowers thus pollinized were sown in Half-plot I., Series III.

EXPERIMENTS WITH EGGPLANTS.

In 1900 cross-pollination was effected between the "New York Improved Spineless" variety of eggplant and one that is known as "Early Long Purple." The new greenhouse provided for the propagation of a large stock of plants from the seeds of fruits that resulted from the above work in crossing. The following season was unusually favorable for the growth of eggplants, and two plots were occupied with the crosses, while other portions of the area contained specimens of the parent species, grown for sake of comparison. The cross was early manifest in the upright habit of the "Long Purple" and the large, broad leaf of the "New York Improved."* There was the purple color of the young stems and leaf-stalks of the former combined with the stoutness of the latter variety. The vigor was so remarkable that it suggested the idea that crossing of varieties might be of importance for this point alone.

When the fruits reached marketable size the evidence of a cross was confirmed, because instead of the long, slender and usually curved form of the "Long Purple" or the nearly oval shape of the "New York Improved," there was a fruit that closely combined the characteristics of the two and produced a shape agreeing with that of the "Bartlett" pear. In weight it was heavier than the "New York Improved," and agreed with it in color. No change in this latter feature was expected, because both parents were of a handsome purple color.

A serious objection to the "Long Purple," as grown here for years, is the lateness in coming into bearing. The fruits, although of high quality, are small, and altogether the variety is not profitable. The large slices of the oval fruits of the "New York Improved" are not well suited for the frying-pan, while the longer and smaller fruit of the cross are of a convenient size for cooking and the table.

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*The term "Spineless" of the full, long trade name is omitted because the "spines" were much in evidence.

The cross has a desirable size and shape and is an improvement upon the "New York Improved" in its superior quality. In the "Long Purple" the seeds are confined to the lower half of the fruit, and the cross under consideration holding to this characteristic gives two-thirds of its fruit free from seeds, and therefore several slices that are solid flesh.

A striking fact in connection with this cross, in its first season, was it earliness, for its plants began to yield marketable fruits on July 20th, while it was August 8th before they could be gathered from the "New York Improved," and were rare upon the "Long Purple" until after September 10th.

In 1902 the crossed eggplants occupied Plot II., Series II., and Plot II., Series III., and were the representatives of four selected fruits of the previous crop. The plants were thrifty, and it was observed that toward the close of the season the parent sorts ceased blooming, while these crosses blossomed freely up to the time of frosts, and then the plants contained many young fruits. It was noted that the general shape, previously mentioned, was adhered to and not over 10 per cent. of the plants produced fruits of the "New York Improved" type, while none were long and slender like those of the "Long Purple." During this season no less than eighteen commercial varieties, all that could be readily procured, were grown to compare with the new cross, and while there were several that seemed alike, none of them resembled the cross either in great vigor of plant or shape of fruit. Several cross-pollinations were made between some of the widely separated forms, as the "Black Snake," a long, slender and crooked fruit, and "Round White," a handsome fruit, about the size of an egg, and the standard sorts, as "Black Pekin," and the "New York Improved."

Eggplants in 1903.

The work with eggplants the past season was devoted chiefly to crossed stock occupying the greater part of three plots, namely, Plot II., Series III., Plot II., Series IV., and Plot III., Series V. Unfavorable weather prevailed throughout the summer, and the plants grew slowly and were later than usual in producing fruits of a marketable size. The same conditions seemed to be equally unfavorable for the development of the leaf-blight and fruit-rot, usually so injurious to this crop. The foliage of the Experiment Area plants was practically unharmed, and the fruit-rot did not make its appearance until late in the season, and developed much slower than usual. No fungicides were applied during the summer.

The two plots in Series III. and IV. contained about 200 eggplants, representing the third generation resulting from the crosses made in 1900 between the "New York Improved" and "Early Long Purple" varieties. The seed producing this season's stock was taken from fifteen selected fruits of the crop of 1902. The number of plants from a single fruit varied from ten to about sixty.

No record was kept of the number of fruits produced, but the third-generation stock began fruiting as early and were as productive as plants of the parent types. Some of the fruits resembled in form and size those of the original parents, but the majority were noticeably different and more or less bell-shaped.

In the first half of Plot III., Series V., the following varieties of eggplants were grown the present season:

1. "New York Improved."
2. "Black Pekin."
3. "Early Dwarf Purple."
4. "Round French."
5. "Striped."
6. "Delicatesse."
7. "Round White."
8. "Mammoth Pearl."
9. "Black Beauty."
10. "Early Long Purple."
11. "Long White."
12. "Black Snake."
13. "Japanese."
14. " No. 9,297.
15. " " 9,298.

Many of the above varieties were grown in the Experiment Area in 1902 and were briefly described in the report for that year (pages 384–5). The "Black Beauty" variety was given a more satisfactory trial this season and is a desirable sort. In number and form of fruits it resembles closely the "New York Improved," but of larger size.

Japanese Eggplants.

Of the three Japanese sorts, No. 9,298 is the only one that showed much value. It resembles closely the "Black Pekin" variety. The other two have not been especially productive, and their fruits have been too small to be of any particular value. All three of the Japanese varieties have been crossed with the "New York Improved," and results of such crosses may be reported later.

Plate III. shows the three types of Japanese eggplant fruits. The first lot of six plants to the left are from seed sent direct from Tokio, Japan, by Mr. D. G. Fairchild, in letter under date of June 3d, 1902. It is seen to be a very slender fruit and usually much bent or twisted. The sort shown in the middle of the plate is from seed sent out by the Government under the list number 9,297, and is elongated pear-shaped. The third bears the Government number 9,298, and is a nearly round variety, and, as before stated, resembles the "Black Pekin" in shape, color and size.

New Crosses of Eggplants.

The following new crosses of eggplants were grown the present year:

1. "New York Improved" upon "Black Snake" gave fruits that were ten to twelve inches long and three to four inches wide. The color is like both parents and therefore purple. The quality is excellent and the shape is desirable from the culinary standpoint, as it permits of numerous slices of acceptable size for cooking and serving. On account of the shape of the fruit they rest by the lower end upon the ground and are less liable to decay than the round sorts.

2. "Long White" upon "New York Improved" gave fruits varying much in color and shape, as the parents were quite unlike in these respects. The curved form of the male parent was present in many of the crosses, while its white exterior blended with the purple of the mother plant in producing a variegated surface, some fruits being spotted white and purple, others somewhat striped, and others of a nearly solid shade of green.

3. "Round White" upon "Black Pekin" gave fruits that in variety of colors were nearly the same as in No. 2, there being a blending of

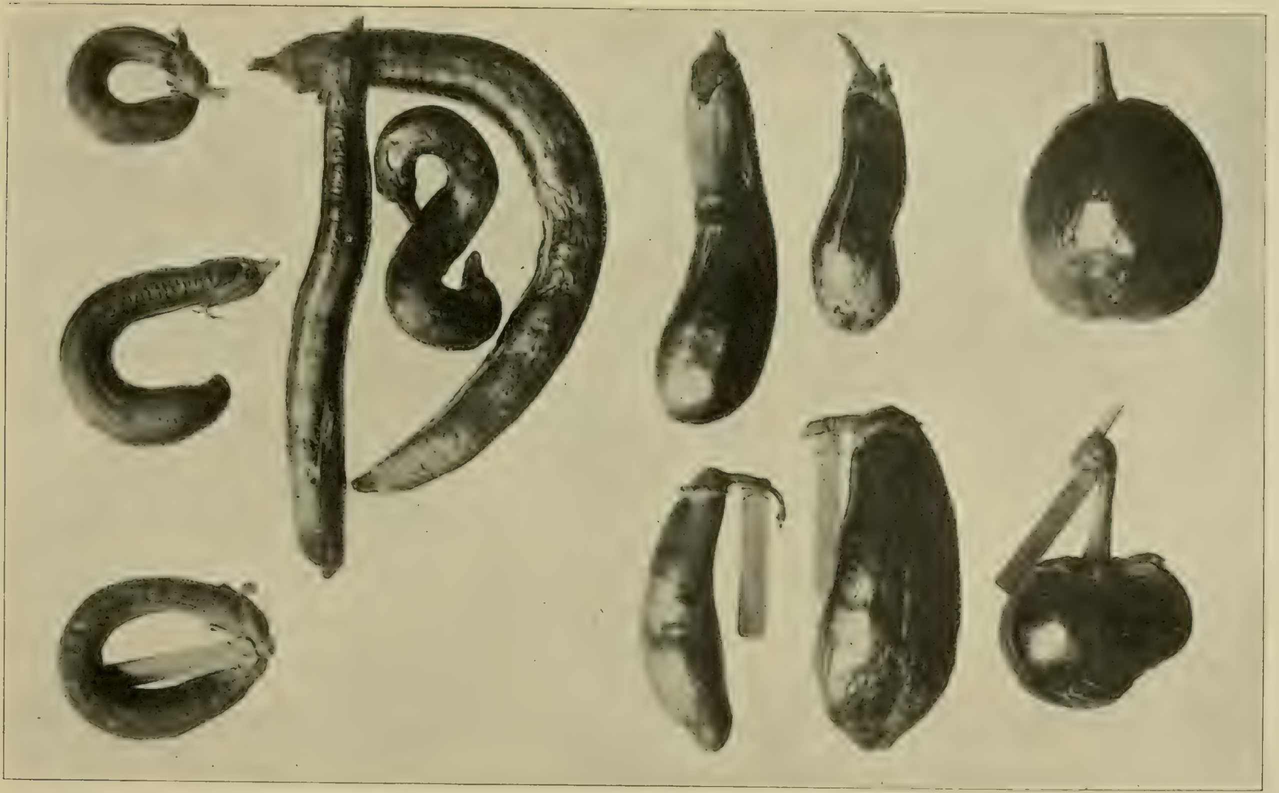

PLATE III.

Japanese Eggplants. Three varieties are shown in the upper portion of the engraving, and with fruits from pollinations with "N. Y. Improved" shown below with labels.

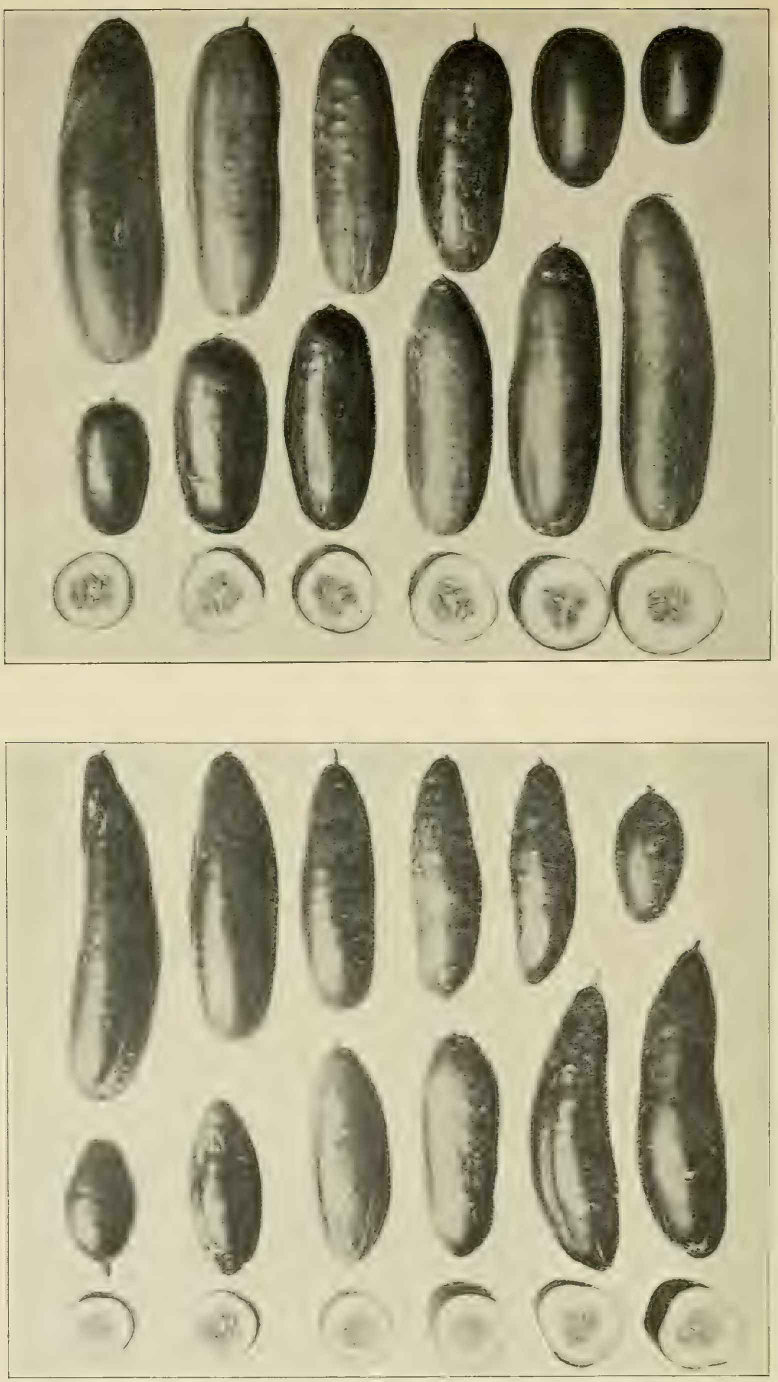

PLATE IV.

Cucumbers. Upper half shows a series of "White Spine" and "White Pearl" crosses. Lower half shows a corresponding set of "Telegraph" and "Zuaim" crosses.

white and purple here as in that case. In shape, however, there was a decided difference, for here both parents were of the round type and the crosses deviated but little from the form common to the two parents.

4. "Fordhook Improved" upon "Mammoth Pearl" gave a mixed lot of crosses, some of the fruits being purple, while others were white. The male parent does not differ essentially from the "New York Improved," and the mother plant is close to the "White Pearl." There is, therefore, in this cross a blending of the large, well-formed purple sort with a much smaller, more slender and white variety.

The one thing that deserves special mention in this connection was the remarkable vigor of the crossed plants and their great productiveness. They occupied a half plot, while adjoining them were standard commercial sorts, and the difference was remarkable. The crossed plants averaged fully twice the size of the others and kept in bloom up to the time of hard frosts—near the 1st of November.

Two years ago, when the cross between "Long Purple" and "New York Improved" were grown for the first time, the same observation was made and set down in the report for that year in the following words: "The plants of this cross have proved of remarkable vigor, so great, in fact, that it has been suggested that for this reason alone the cross is a great gain." The crossing of eggplants is not a difficult matter, the flowers in all their parts being of large size, and it is recommended that it be engaged in by growers of this truck plant for the added strength and consequent fruitfulness that it brings.

BREEDING OF CUCUMBERS.

Plot IV., Series I., was devoted to the crosses of the "White Spine" and "White Pearl" cucumbers that were obtained in 1899. Plate IV. (upper half) shows the range of variations in these crosses, the fruits being taken when nearly mature. It is seen that some of them are very short, not much longer than broad, while others are quite long. Some of those of medium size were comparatively smooth, and by selecting from these it is hoped to obtain a fruit that will be more desirable than either of the parents.

A corresponding set of fruits was selected from the plants (Plot III., Series III.) of the cross of "Telegraph" upon "Zuaim," secured in the greenhouse during the winter season. The two smallest fruits are full-blooded "Znaim" cucumbers, grown for the purpose of comparison. As stated in the last report (pages 389 and 390), this is an old variety that has long been grown commercially in Austria, the seed of which was secured by Mr. D. G. Fairchild, of the United States Department of Agriculture. With us the "Znaim" produces short, plump fruits and in limited numbers. The "Telegraph," upon the other hand, is a popular indoor variety, the fruits of which are very long, comparatively seedless and with a consequent firmness of flesh. It was with the hope of developing these characteristics in field-grown cucumbers that the "Telegraph" was used as a pollenizer. By comparing the series of sections of six different fruits of this cross with the corresponding series for the "White Spine," "White Pearl" cross, it will be seen that there has been some loss of seediness and corresponding gain in the flesh. The effect of the male parent is shown in the tapering stem end of the crossed fruits. A glance at the two sets of fruits will make this very apparent. Should one center his vision upon third fruit from the left in each of the six rows the differences in mind will be quickly established. It is this grade of fruits that is reserved for seed.

The year was an exceedingly poor one for all crops of this class, and the yield was poor and the fruits not what might have been expected with all conditions favorable. Melons, for example, were an entire failure in many parts of the State.

CROSSING OF SQUASHES.

During 1903 the whole of Series 0 was in crossed corn, and, following the old-time practice of farmers in growing pumpkins with their corn, squash seeds were planted in some of the hills. Thus a small portion of Plot I. received seeds of "Long Island White Bush" squash and another part a few plants of "Mammoth Bush Summer Crookneck" were grown, while a third portion carried some vines of a novelty named "Delicious." A part of Plot II. had the "Golden Hubbard," in addition to the corn, while Plot III., in like manner, bore the old standard "Hubbard," and the remaining plot (IV.) had some vines of the "Boston Marrow."

During the season time was found for attempting some crosses. Thus, pollen was taken from both the summer varieties to pistillate flowers of each of the four late sorts, and the reverse was also true, but in no instance was any fruit obtained as a result of the various attempts, fully twenty-five, between the summer and the late varieties. Otherwise were the results between the two bush varieties, and full-sized fruits were obtained with both the "Flat" and the "Crookneck" variety, as the mother parent and these specimens resembled in all respects the variety furnishing the pistillate flowers in the cross.

Among the late squashes crosses were secured only between the "Hubbard" upon the "Boston Marrow" and the "Delicious" upon the "Golden Hubbard." The "Hubbard," for example, always failed when attempts were made to breed other varieties upon it. In passing, it may be remarked that the wet weather that prevailed while the bags were upon the blossoms may have largely decreased the successes, for the young fruits (pistils) decayed rapidly when covered, and the setting of fruit was poor with flowers left in normal condition.

It is seen that there are four crosses secured—that is, the reciprocal ones with the two summer sorts, and the two which involve all the four late varieties, which will be enough for a supplemental crop in the plots of corn that it is planned to grow the coming year. The two varieties of summer squashes that have been crossed upon each other differ greatly in the form and color of their fruits, those of the "Long Island Bush" being white, disk-shaped, and, except for their scalloped sides, are comparatively smooth. There is very little difference in the general appearance of the fruits of different plants of this variety. The "Crookneck" squash produces long, yellow and somewhat bell-shaped fruits, and there is often a noticeable difference between the fruits of different plants; in some the smaller or "neck" end is much curved, and in others but slightly. Some may be thickly beset with wart-like outgrowths, while others are nearly smooth. As to size of fruits and productiveness, the two varieties did not seem to differ much; marketable fruits ranged in weight from one and a half to four pounds.

The foliage of the two sorts is much alike, except that that of the "Crookneck" is somewhat darker and the leaves of the "Long Island Bush" are slightly mottled. The leaves of both, unlike those of the winter sorts, are deeply lobed. The leaves are also smaller than those of the winter varieties.

The four varieties of winter squashes selected for crossing differ strikingly from each other in some respects. In color of foliage there seems to be very little, if any, contrast. The leaves of the

"Hubbard" are somewhat larger than those of the other three, and while many of the leaves of the "Boston Marrow" and "Golden Hubbard" are apt to be crinkled or fluted, those of the "Hubbard" and "Delicious" are plain.

In the cross of "Hubbard" upon "Boston Marrow" we have a union of two varieties having very different fruits; those of the "Hubbard" are dark green in color, while those of the "Boston Marrow" range from a light yellow to a darker reddish yellow. In form the "Hubbard" tapers gradually at both ends, while the "Boston Marrow" ends abruptly, tapering at the stem end only. At the Experiment Area the latter variety produced larger fruits than the "Hubbard."

The "Golden Hubbard" squashes may be a light yellow or a darker orange-yellow (different shades than appear in the "Boston marrow"), except at the outer tip, which is dark green. Though smaller than the "Hubbard" squashes, they are of nearly the same shape.

The recently-introduced "Delicious" variety has fruits of about the same shade of green as those of the "Hubbard," and of much the same form as those of the "Boston Marrow." In size, the few fruits obtained this season were fully as large as those of the "Golden Hubbard."

There was considerable difference in the number of plants of the different varieties and no record of number or weight of fruits was kept, but it is thought a like number of plants of "Golden Hubbard" yielded a greater number of fruits than any of the other winter sorts. By weight, however, the "Hubbard" may be more productive, since its fruits averaged a large size. The "Boston Marrow" would be given third place in this list, although its yield was fairly good. The "Delicious" made but a poor showing, since it commenced to fruit much later than the other sorts and matured only about half a dozen fruits.

In connection with the question of pollenation and crossing among squashes, it is well to look at the botanical side of the matter. The genus Cucurbita, to which the squashes belong, is made up of the following annual species under cultivation: (1) *Cucurbita Pepo* L.; (2) *C. moschata* Duch.; (3) *C. maxima* Duch. To the first belong the pumpkins which were grown by the American Indians in their fields of corn before this country was settled by Europeans, and may be native to the warmer portions of this continent. From this species has come a group of gourds, like the "nest-egg," "orange," "mock-orange," "pear" and "Turk's turban," that are grown to some extent for ornament, and, being hard-shelled, serve as domestic utensils. These represent the *C. Pepo* var. *ovifera*, so named from the egg form above mentioned. A second variety includes the bush sorts of plants that run little or not at all, to which the name of *C. Pepo* var. *condensa* has been assigned, from its compact or condensed habit of growth. Under this variety are gathered the scallop and crookneck squashes and bush pumpkins, and furnish the many sorts of summer squashes.

The *Cucurbita moschata Duch.* are long, running like ordinary pumpkins and squashes, which Bailey* states is "possibly of East Asian origin." This is not grown with us to any extent, and furnishes, among others, the winter or Canada crookneck variety.

Under *Cucurbita maxima* Duch. are classed the forms that are most generally termed squashes, as illustrated by the "Hubbard" and "Marrow" types. The flesh of the fruit is orange, and in shape is not crooknecked.

These three species differ in nothing more strikingly than the stem to the fruit. In *C. Pepo* it is very hard and deeply grooved close to the fruit at maturity, while *C. moschata* has the stem also grooved, but much enlarged as it joins the fruit, while in *C. maxima* it is large, soft and is neither ridged or enlarged as it joins the fruit. The leaves of *C. Pepo* are much lobed and dull green, and in *C. moschata* they are rounded and grayish, while *C. maxima* has a kidney shape in evidence.

Bailey states that *C. Pepo* and *C. maxima* do not cross, neither do *C. maxima* and *C. moschata*, but *C. Pepo* and *C. moschata* have been bred together. Our successful pollenations have been, first, between varieties of *C. Pepo* and, secondly, between sorts of *C. maxima*, and all attempts to hybridize the two species have resulted in failures.

There is an opinion more or less current among truckers and others that melons, cucumbers and pumpkins will mix with each other, and this subject naturally comes up with the work that is given above. Many melons are poor in quality and suggest that they have been hybridized with pumpkins, squashes, cucumbers or other species of the same family. This conclusion as to origin, as determined by taste and possibly general shape of fruit, which varies greatly in many instances, is contrary to the careful work of various experts. For example, Professor Naudin experimented many years with different species and found that they rarely hybridized, and then the results were usually sterile; Professor Bailey made numerous pollenations between our two common species of *Cucurbita*, and he states that "all our experiments show that *Cucurbita pepo* and *C. maxima* do not hybridize." A few years later Professor Pammel made extended attempts to produce hybrids, and from his work concludes:* "(1) that pumpkins (*Cucurbita pepo*) and squashes (*Cucurbita maxima*) will not hybridize; (2) that pumpkins and watermelons (*Citrullus vulgaris*) will not "mix," nor will squashes and melons "mix:" (3) cucumbers (*Cucumis sativus*), sugar and muskmelons (*Cucumis melo*) will not hybridize, nor will they "mix" with pumpkins; (4) the different forms of *Cucurbita maxima* will readily cross with each other—"Mammoth Chili," "Hubbard," "New Prolific Marrow," "American Turbin," &c.; (5) The forms of *Cucurbita pepo,* as the "Long Warted," "Nest Egg Gourd," "Vegetable Marrow," "New Golden Bush," "Bush Scalloped," "Italian Striped," "Perfect Gem," "Common Pumpkin" and "Sweet Sugar" will readily cross with each other.

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* Cyclopædia of American Horticulture.

When we find that two species of the same genus (*Cucurbita*) do not hybridize, it is scarcely to be expected that plants in different genera will "mix."

EXPERIMENTS WITH TOMATOES.

The crossed tomato stock the past summer was confined to the first three plots of Series II., and included about 200 plants. These were descendents of a few special selections from the first crop of crossed plants in 1900, and represent the fourth and, in a few instances, the fifth generation. A majority of the plants represented combinations of a few of the original numbers. Such combinations were made in the summer of 1901, when considerable crossing or breeding was done of the choicest representatives of the second generation.

A type of tomato has been developed from a combination of No. 144 upon No. 150 (144/150), the original parents of which came from the same red fruit that resulted from a cross of "Golden Sunrise" upon "Dwarf Champion" in 1899. The yields of these parents for 1900 are given for the season in the tables in the report for

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* Results of Crossing Cucurbits, Bulletin 23, Iowa Experiment Station, 1893.

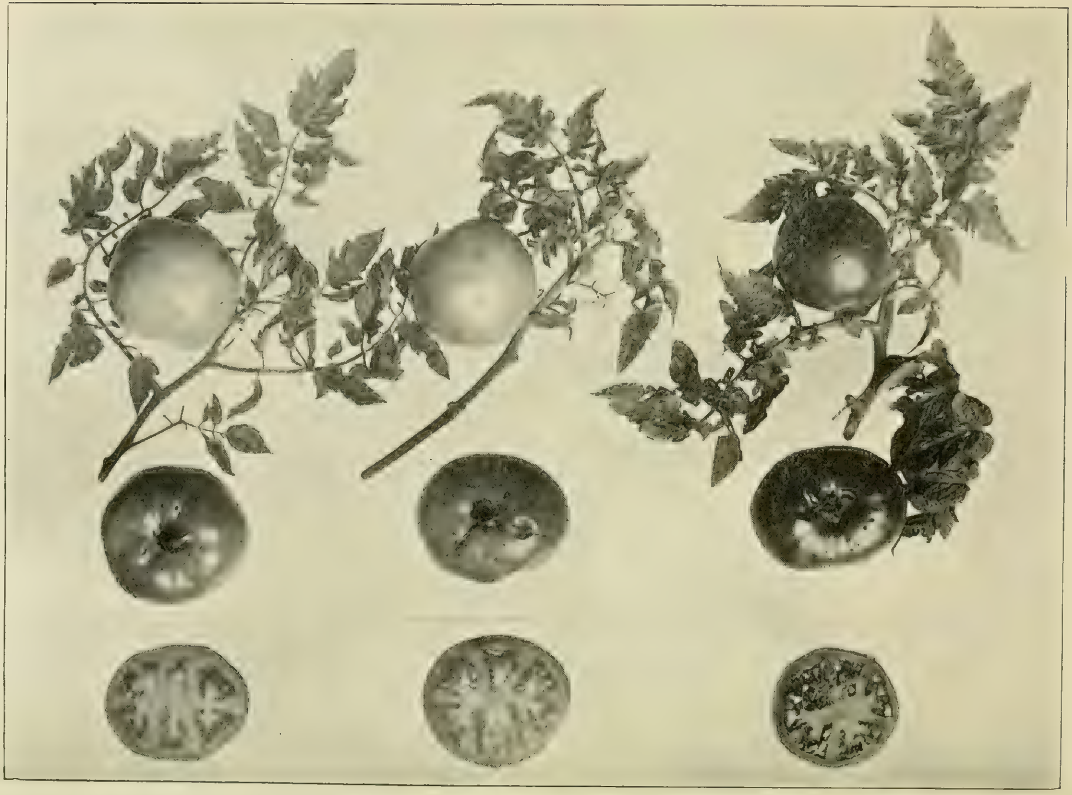

PLATE V.

Tomatoes   The "Station Yellow" is shown in the center in three views, and foliage, with the male parent, "Golden Sunrise," upon the left, and the mother variety, "Dwarf Champion," upon the right.

that year. The two plants were remarkable for their good qualities, and breeding them together has resulted in a type of plant resembling the "Dwarf Champion," or orginal mother plant, but with a fruit that is yellow, like the male parent, or "Golden Sunrise."

Plate V. shows this new tomato, called "Station Yellow," in the middle row of the picture, while the male parent variety, the "Golden Sunrise," is upon the left, and the female parent, the "Dwarf Champion," is to the right of the cross. It should be said, in justice to all three sorts, that the specimens for the photographs were taken at the close of the season—about the middle of October—and when there was no opportunity to make any selection of the best fruits. The upper portion of the picture shows the general contour of the tomatoes looking from the blossom end, while the corresponding view upon the stem end is shown in the three fruits in the middle row below, which are given interior views of the same three varieties of fruits. The first and second row from the left are yellow fruits of nearly the same character, the "Station Yellow" being somewhat more firm or "solid," and therefore less polygonal or "angled" in general outline. The latter variety has a tendency to develop a blush upon the maturing fruit, perhaps due to the cross with the red "Dwarf Champion." The character that makes the variety distinct is in the vine, which is of the upright habit of its red mother, and does not have the prostrate or sprawling method of growth of the "Golden Sunrise." The nature of the foliage of the three varieties is indicated by the spray of each that are shown in the upper part of the plate. To those who know the bushy habit of the "Dwarf Champion," with its thickly-set leaves upon a plant of under size, and the nearly opposite characteristics of the "Golden Sunrise," will expect what is obtained in the cross, namely, a larger plant than that of the female parent, and one with something of the great vigor of the male parent. To say that it is a yellow "Dwarf Champion" is not telling the whole truth, because the differences are more than color of fruit. The plants and the fruit are both somewhat larger than the "Dwarf Champion," and the foliage is not so much infolded or "curled," or "potato-like," as some are pleased to call it.

On account of the tendency to blush that is developed in the "Station Yellow," it has been selected as a sort with which to breed further with red varieties, in the hope of establishing a kind with the blush fully developed.

No. 177 was originally from a red fruit resulting from a cross of "Golden Sunrise" upon "Dwarf Champion" in 1899. Concerning the plant the following is quoted from the Report for 1900 (page 438): The plant (No. 177) "was a giant in stems and foliage, standing high above the surrounding plants. Its leaves combined the characteristics of the two parents, and the flowers were of unusually large size. The most remarkable point was the smallness of the fruits, being about an inch in diameter and two ounces or less in weight, with seeds ranging from none to six for each fruit. There were only twenty-seven fruits produced upon this plant, four of which were green at the close of the season. The cross expressed by the numbers 177 upon 177 (177/177) indicates a union of two plants from the same original parents, some of which were made.

The most progress toward a seedless fruit seems to have been made in case of a number of plants developed from the No. 177. Seeds of third-generation fruits of this number were sown in the greenhouse the past winter, and some of the seedlings were remarkable owing to their having three, and in one instance, four cotyledons. From these seedlings a few small and almost seedless fruits were obtained and from these came, for a late setting, the plants in rows 5 to 10 in Plot III. Several of these have produced more and larger fruits than their parent plants and bore a very limited number of seeds. Specimens of these fruits are shown in Plate VI. The number of seeds in each fruit ranged from five to fifty, while those of ordinary tomatoes is among the hundreds.

Tests of Varieties of Tomatoes.

A portion of Plot IV., Series V., was given to a test of several varieties of tomatoes, some of them being classed as "Novelties." To the test was added the "Dwarf Champion" and "Golden Sunrise" for sake of comparison. The table below shows some of the results:

Name of Variety.	Total No. Ripe Fruits.	Total No. Green Fruits.	Grand Total.	Average per Plant.	Rank in Size.
"Dwarf Champion"	103	20	123	24	8
"Golden Sunrise"	232	36	268	53	5
"Freedom"	374	47	421	84	6
"Crimson Cushion"	253	31	284	56	2
"Chalk's Early"	312	19	331	66	7
"Ponderosa"	209	38	247	49	1
"Marvel"	431	31	462	52	3
"Magmus"	428	62	490	98	4
"Thorburn's Earliest"	528	60	588	117	9

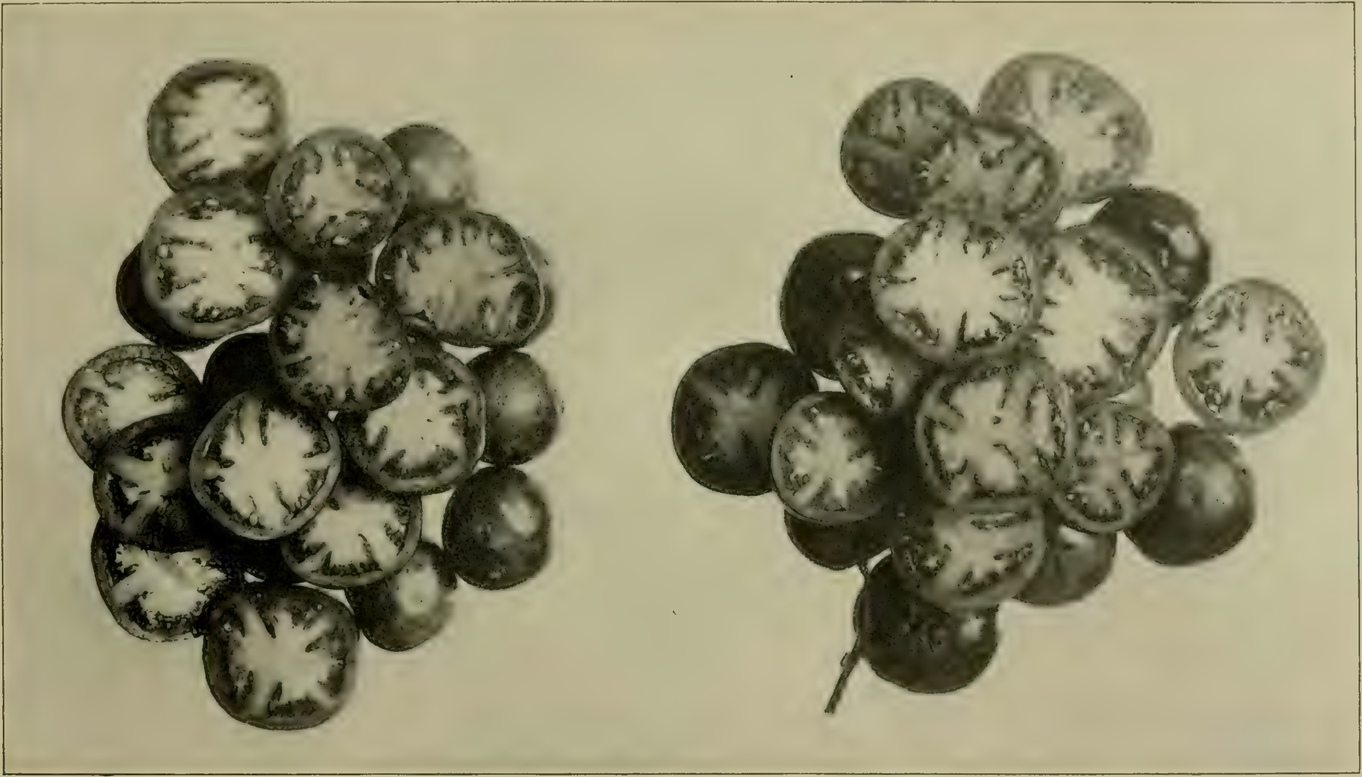

PLATE VI.

"Seedless" Tomatoes The group of fruits upon the left are from cuttings of No. 177 grown in the field. The fruits upon the right are from various seedlings of No. 177.

It is seen that fruits of the "Thorburn Earliest" outnumbered those of any other variety, but they were of the smallest size. The "Magus" stood next in fruit record, and the tomatoes ranked fourth in size, so that this variety gave a greater yield in pounds of fruit than any other sort. This variety has a somewhat upright vine, "potato-leaved," some would say, and resembled much the "Dwarf Champion," but is a much larger plant. The largest tomatoes were produced by "Ponderosa," but it was only second in number of fruits per plant. The "Dwarf Champion" variety did poorly in this test, yielding only twenty-four fruits per plant, and these of the usual medium size.

EXPERIMENTS WITH BEANS.

The first three belts of Plot I., Series V., were planted June 1st with alternating rows of "Green Flageolet" and "Saddle-back Wax" beans; and on June 27th the same varieties were planted in belts 4, 5 and 6. While the stand of the "Saddle-back Wax" sort was good, there were scarcely any plants of the "Green Flageolet" obtained from either planting. With the few that appeared, about a dozen attempts were made to cross-fertilize "Saddle-back Wax," only one of which was successful. An average-sized "Wax" pod containing three black beans was secured.

Considerable leaf and pod-spot (*Colletotrichum*) developed upon Experiment Area beans this season. The product of a late fall planting "Saddle-back" and "Bountiful" varieties was much more severely infested by disease than earlier crop.

Experiments with Dwarf Lima Beans.

Lima beans have been grown upon the Experiment Area since 1896, when they were employed to test various fungicides for the diseases of this crop. The following season, Plot IV., Series III., was planted to three varieties of dwarf lima beans, namely, "Burpee," "Dreer" and "Henderson." For this crop the "Burpee" far exceeded the other varieties in marketable pods for the same area—*i. e.*, producing 99 pounds to 45 for the "Dreer" and 39 for "Henderson." By shelling the pods of each variety the ration of productiveness of seeds was determined to be as 20, 9 and 8, respectively, for the three sorts. In time of maturing there is no difference between "Burpee" and "Dreer," while the "Henderson" gave pickings at a much earlier date and has a long period of fruiting. At that time a full description of each variety was prepared and published later in the report for the year. The "Burpee" and "Dreer" are closely related and belong to a distinct variety of the species, with the botanical name in full as follows: *Phaseolus lunatus* var. *macrocarpus* Benth.—that is, the large-fruited lima—while the "Henderson" belongs to the species, but not the variety, and botanically is simply *Phaseolus lunatus* L.

In order to show something of the history of the three sorts and how recently they have been developed, the following is given as gathered from a bulletin* by Professor Bailey. The "Burpee" originated with Mr. Asa Palmer, of Kennet Square, Pa., and was introduced to the public by Mr. Burpee in 1890 as the "Burpee Bush Lima." In 1883 Mr. Palmer found one plant of his pole lima beans had rerooted after being eaten by cut-worms. It remained dwarfed and produced a few seeds, and from these seeds the variety was developed. The "Dreer" originated from the "Challenger" pole bean by selection of dwarf forms which a Mr. J. W. Kumerle found growing in his field of beans at Newark, New Jersey, and was introduced in 1889 by both Thorburn and Dreer. It is of the same blood as the "Burpee." Of the "Henderson," Professor Bailey writes: "It was picked up twenty (thirty now) or more years ago by a negro who found it growing along a roadside in Virginia. It was afterwards grown in various gardens, and about 1885 it fell into the hands of a seedsman in Richmond. Henderson purchased the stock of it in 1887, grew it in 1888 and offered it to the general public in 1889."

Thus all varieties were introduced within two years.

In 1898 the experiments with lima beans were limited to the two sorts, "Burpee" and "Henderson," and while the study of the diseases and their treatment were leading points in the work, a comparison of the two varieties was not overlooked. It was found that the "Henderson" is much less subject to the various bean diseases than the "Burpee." The former will bear a half more plants in a row, owing to their smaller size, and then weigh but a trifle more than two-thirds as many of the "Burpee." The yield of fruit is, however, under such conditions much in favor of the "Henderson," and the latter furnishes pickings much earlier than the "Burpee" and fully as late in the season.

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*The Dwarf Lima Beans, Bulletin 87, N. Y. Cornell Experiment Station, 1895.

During 1899 belts 1, 2 and 3 of Plot IV., Series III., were in lima beans for the fourth successive crop, and with the two varieties of the previous season grown as before in alternate double rows throughout the half plot. The sprayings were eleven in number, extending from June 2d to September 12th, and there was very little disease, the "Henderson" pods being all in healthy condition. The records show that for 1899 the yield of marketable pods, in pounds, was greater for the "Burpee" than for the "Henderson," thus making the average for the past two years about equal.

In 1900 two adjoining belts (1 and 2, Plot III., Series 0) were planted with seeds from plants suspected of being possible crosses between "Burpee" and "Henderson" while standing in the adjoining rows of the crop of the previous year. In the "Burpee" belt there were twenty plants that were different from the rest, and appeared to be crosses between the two above-named varieties. Many of these plants were much smaller than the "Burpee" and near the size of the "Henderson," and had the darker and more glossy foliage of the latter sort. Some of them, however, were nearly as large as the "Burpee," and showed but little of the characteristics of the "Henderson."

A record was made in the Annual Report (1900) of the general type of the plant—that is, whether nearer one or the other plant—and a number of green and ripe pods and a plate showed the form and relative size of the pods and seeds.

In 1901 seeds of all the twenty plants above mentioned were planted, and all produced from one to seventy-two plants, excepting two (Nos. 1 and 16), which failed. In vigor the sets of plants were generally satisfactory. "There were many individual differences from the time the seedlings unfolded their first true leaves, and the plot showed those evidences of a mingled blood that plant-breeders find so difficult to set down in words." Some rows were more uniform than others, favoring one parent or the other, as the case might be. All the plants of the plot remained true to the dwarfed type excepting seven, and those were given poles and climbed, with one exception, with the characteristics of genuine pole beans. Opportunity came for testing the quality of some of the crosses, and it was found to compare favorably with that of the "Burpee" and superior to that of the "Henderson." There was a variation in quality, as there was in the character of the plant and seed, among the several sets.

In 1902 selected seeds from the several sets of crossed plants were planted and a crop grown and harvested for each. There was little to be added to the observations upon these sets of beans of the previous year.

From this large stock of seeds the following numbers, 2, 4, 5, 6, 15, 18, 19 and 20, were selected as being the most promising.

Crossed Lima Beans in 1903.

Plants representing a fourth generation of the crosses between "Henderson" and Burpee" drawf limas were grown the present season in the first two plots of Series I. The seed was planted in Plot I. June 1st, and not until June 22d in Plot II. The twenty-four rows in the first plot and the first eight in the second were from seed of dwarf limas, selected in 1902 from the most desirable of the crossed plants, and eight such selections were used the present season—a different lot of seed being used for each four rows.

A medium stand of plants was obtained from this "Bush" seed, and of the twenty-four rows in the first plot, six were wholly free from climbing or trailing plants, and six others contained only a few specimens that were somewhat inclined to run towards the end of the season. All the remaining twelve rows contained a large percentage of climbing plants. None but dwarf sorts appeared in four of the first eight rows of Plot II., and in the other four there were six pole limas.

The remaining twelve rows in Plot II. were from seed of crossed plants that had required poles the preceding season. Each three rows represented a different lot of seed.

Considerable variation was noted in the different rows of crossed limas the present season. In case of the dwarf sorts, some rows were earlier than others, and some were especially fruitful. The yield, as a rule, seemed equal to that of an average "Henderson" plant. In certain rows the pods were much like those of the "Henderson" type, while in others they were noticeably larger, although smaller than those of the "Burpee" variety.

A like variation in fruitfulness and size of pods occurred among the crossed pole limas. The pods of these, in most cases, were larger than those of the "Henderson" variety, and some were nearly equal to those of the "Burpee."

The limas were not seriously harmed by disease in 1903. The pods were lightly infested by the pod blight, and mildew became quite conspicuous, but not until late in October. No fungicides were applied.

Varietal Study of Lima Beans.

In connection with the work in crossing and breeding lima beans a small space—a row thirty feet long—was given to a test of each of the following varieties, with the results as shown in the table below:

Kind.	Number of plants.	Number green pods.	Number dry pods.	Total pods.
"Henderson"	36	664	205	869
"Burpee"	46	165	.....	165
"Thorburn"	38	15	.....	15
"Dreer"	44	225	.....	225
"Willow-leaf"	47	709	181	890

In this set there are two groups of dwarf limas represented, the first and last named being of small stature, dark-green foliage and with the pods and seeds comparatively small. The other three varieties are closely related, with large plants and pods and seeds. Plate I. of the report for 1901 shows the seeds of "Henderson" at 1 and 4, and of the "Burpee" at 3 and 6, both in the green and ripe condition.

It is seen that the "Henderson" and "Willow-leaf" were far superior in productiveness to the other three sorts. This may in part be due to the season, which was very dry in May, so that the plants had a late start. This was followed by an unusually wet June and August. A more even rainfall throughout the growing season might have given quite different results.

The only disease that seemed to make any headway among these trial beans was the mildew, and for its development the wet August seemed particularly favorable. It was noticed from time to time upon the three larger sorts, and doubtless had somewhat to do with their low yield, but upon the smaller podded sorts it was not in evidence.

All of the five varieties were remarkably uniform, with the exception of the "Willow-leaf," among which were fourteen plants that were somewhat larger than the others, and with the leaves broader than the type. The pods of these plants were somewhat above the average in size and in number to each plant. The seeds of these have been saved for further testing as to fixedness of character, productiveness and market value.

Plate VII. shows small heaps (thirty seeds) of each of the five varieties, as named below their respective seeds. The lower row shows corresponding heaps of the six bush sorts of the crossed limas that were grown the present season.

It is not easy to make a comparison of these several sorts, because they have no one point that is a unit of measurement for all. However, the number of pods per plant has been determined, and, avoiding all fractions, is as follows:

"Henderson"	24	"Burp.-Hend., No. 2"	8
"Burpee"	4	"Burp.-Hend., No. 4"	11
"Thorburn"	5	"Burp.-Hend., No. 5"	9
"Dreer"	5	"Burp.-Hend., No. 6"	8
"Willow-leaf"	19	"Burp.-Hend., No. 18"	10
		"Burp.-Hend., No. 19"	10

The "Henderson" and "Willow-leaf" lead in number of pods, but they are smaller than those of the other sorts.

EXPERIMENTS WITH FUNGICIDES.

The systematic use of fungicides for the current year has been confined to spraying in the greenhouse, a report of which has appeared in the bulletin* issued during the summer. In the field spraying has only been done to preserve the crop plants from the ravages of insects. The tests with fungicides were omitted that the effect of clean culture might be noticed for the year. As stated elsewhere, the eggplants were comparatively free from disease until late in the season, when the moist conditions favored the rapid growth of the fruit rot. In like manner the tomato plants suffered but little until in September, when the leaf-spot became evident, and during the following month the foliage was considerably affected. The plants upon the Experiment Area were not blighted to the extent seen elsewhere, and this seems due in part to the regular practice of keeping the vines clean of diseased parts during the growing season and burning all vines and rubbish on the Experiment Ground whenever the crop is removed.

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* No. 167. Some of the Newer Fungicides. June 29th, 1903.

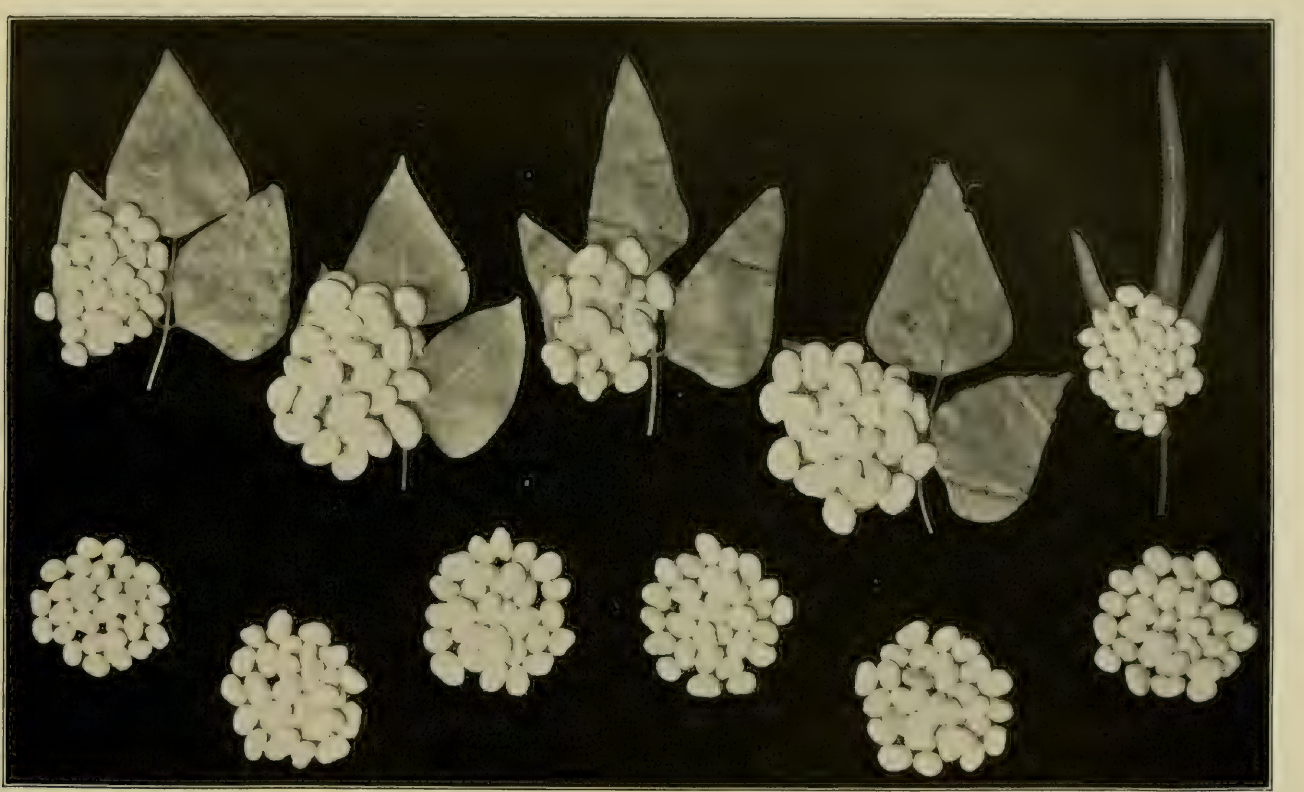

PLATE VII.

Dwarf Lima Beans. Piles of twenty-five seeds of five standard sorts in the upper row, and of six of the crosses in the lower row.

EXPERIMENTS IN SHADING.

But little has been done the present season in the matter of shading. While previous experiments have shown that an artificial cover may be of considerable service to certain crops, this important feature of the experiment work has been set aside owing to pressure of other things.

The use of lath-shading* (with spaces between the lath equally the width of the lath—that is, half-shading) has proved very effective with nasturtiums the present season. These plants often have their foliage burned by the hot sun, and a small amount of shading will prevent this. In case of the canary-bird nasturtium (*Tropaeolum Canariense*), the lath-shade made all the difference between plants with burned leaves and no flowers and those with sound foliage and abundance of bloom. The lath frames were placed high up above the plants, so that they did not interfere with the climbing of the plants or the care of the ground around them.

EXPERIMENTS WITH JAPANESE REDBUD.

In 1896 two dozen plants of the Japanese redbud (*Cercis Japonica*) were set out in a single row in a portion of the Experiment Area devoted to ornamental plants. In a visit to the nursery from which the plants were afterward obtained it was determined that the cercis was badly attacked by a leaf-spot fungus (*Cercospora cercidicola* E.) which produced large, circular, brown spots in the handsome leaves, which afterward died and fell to the ground. In September of the first season of the experiment after faithful spraying of certain plants with fungicides, a visit was made to the nursery from which the plants had been obtained. At that time the redbuds, by the thousands, in the nursery rows, were nearly all leafless from the attack of the leaf-spot. The difference between the plants and those taken to the Experiment Grounds, many miles away, was very striking. This is a forceful illustration of the healthfulness that may follow the removal of plants from a locality where its kind has been grown for years in large numbers and a disease has developed to a serious extent. As the plants experimented upon were all comparatively free from the leaf-spot, there was no marked difference between the sprayed and the unsprayed specimens.

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* The method of making lath frames is described in the annual report for 1897, page 344.

The experiments with spraying mixtures was continued in 1897, and the record shows that "but very little blight upon the foliage during the whole season, and no marked effect can be recorded for the fungicides." The spraying continued through 1898, "but without results, owing to the absence of the redbud blight." All this time the plants had showed marked differences in hardiness. The record for 1899 contains the following: "Two or three of the trees were much injured during the last winter. No blight developed during the summer, but several were somewhat injured by sun scald."

This tenderness to the extremes of winter's frost and summer's sun has been so great that at the present time the number of the healthy plants is limited to three, while fully half have died and several are unshapely and worthless as ornamental dwarf trees. One of the three that has proved hardy is an especially fine specimen, and nearly perfection in its shape and luxuriant foliage. This plant flowers profusely in early spring and fruits abundantly in autumn. Seeds are gathered from this, and it is hoped that, by careful selection from its seedlings, a hardiness may be obtained, after a few generations, that will place this redbud among our most attractive lawn trees.

EXPERIMENTS WITH LAWN GRASSES.

The nine plots seeded to grasses, as shown in the following table, have been kept cut with the lawn-mower during each season since 1896. The condition, or stand, of each kind of grass is given in percentage, following the plot number and kind of seed sown:

Plot.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
1. Meadow Fescue (*Festuca pratensis* Huds.)....	90	50	40	45	55	60	60	80
2. Fine-leaved Fescue (*Festuca tenuifolia* Sib.)..	5	50	40	40	40	45	45	40
3. Sheep's Fescue (*Festuca ovina* L.)..............	10	50	40	40	30	25	40	40
4. Rhode Island Bent (*Agrostis canina* L.)......	80	80	90	90	90	95	95	95
5. Wood Meadow (*Poa nemoralis* L.)............	60	65	70	85	80	85	90	85
6. Kentucky Blue (*Poa pratensis* L).............	50	65	90	90	85	85	80	80
7. Rough Meadow (*Poa trivalis* L.)................	90	65	70	70	45	70	60	50
8. Redtop (*Agrostis alba vulgaris* With.).........	100	90	70	60	25	25	20	50
9. Perennial Rye (*Lolium perenne* L.)...........	100	85	70	40	20	15	15	40

The "Rhode Island Bent" has held the first place for four years, and gives a very satisfactory turf for a lawn. The texture is fine, but, in dry spells, it sometimes turns brown. In the "Wood Meadow" the makers of fine lawns will find a valuable grass; the turf of this has improved gradually from the start, eight years ago. The "Kentucky Blue" is another grass that has proved very satisfactory and secured a high rating since 1898. Aside from "Redtop" and "Perennial Rye," which have been poor, the other four species have maintained a middle place in the list of varying percentages of merit.

In these plots the weeds have been permitted to grow, the chief of which during the whole season is the dandelion, and in autumn a crab grass fills all vacancies, and is much in evidence in some of the plots.

At one time during the season the plots were left uncut for a time to permit an estimate being made of the mixing that had gone on among the grasses of the various plots. It was thus determined that the "Kentucky Blue Grass" had spread so much that it made up fully 50 per cent. of the first three plots and Plot 9, and was even more largely represented in Plots 5, 7 and 8. It had not made any headway in Plot 4 where the "Rhode Island Bent" held nearly full sway. A little of the Orchard Grass (*Dactylis glomerata* L.) had worked into Plots 1 and 2.

FRINGED PHLOXES.

Phloxes, and particularly *Phlox Drummondii* Hook., have received attention for the past three years, and several species are now represented in the Experiment Area. The large genus Phlox, of seventy species, is so named from the Greek for *flame* on account of the bright red color of many of the flowers. There are four species in the State, one of which, the "Moss Pink" (*Phlox subulata* L.), is the early bloomer that covers many otherwise nearly bare hillsides with a pink mantle and is among the first showy flowers of the season. In the south and west the representatives are much more numerous, as in Alabama* there are eleven species.

The species are herbs and generally perennial, with *P. Drummondii* an annual and a striking exception to the rule. It is of this species that the following is concerned. The Drummond Phlox is a low, erect and much-branching plant, with long leaves, more or less clasping the stem by the broad base. The flowers are many, in flat-topped clusters, and under cultivation has run into a great variety of colors, from white to a very dark red.

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* Plant Life of Alabama, Dr. Charles Mohr, 1901, pages 684–686.

Mr. Drummond, a maker of large botanical collections in the Southern States, collected the seeds in Texas and sent them to England in 1835. The species was described by W. J. Hooker in the Botanical Magazine, along with a picture of the same, and all under the name of the American collector.

Within the space of sixty-eight years the Drummond Phlox has become one of the favorite garden ornamental plants, and Bailey* writes: It "is of the easiest culture. This fact, together with the profusion and long seasons of its bloom, is an important reason for its popularity."

This phlox is a favorite in Europe, and Robinson† writes: "Nothing can excel its beauty and usefulness either as a border plant or for furnishing cut flowers. Its colors are varied and brilliant, and are not injured by bad weather like those of many other flowers. The wonder is that it is not more generally and extensively grown in gardens. It may be used in a variety of ways apart from border decoration. Beds of standard roses carpeted with it are highly effective, and the fact that the plant does not in any way touch the growth and well-being of the standard roses, the naked stems of which they both hide and ornament, should in itself be a sufficient inducement to plant this phlox especially for that purpose. It is also a very suitable plant for the embellishment of rustic vases and boxes, but it is when grown in masses that its beauty and diversity of color is seen to the best advantage."

It strikes freely from cuttings in autumn, and may thus give early flowers in abundance indoors for winter decoration.

With us this phlox is half hardy, and many seedlings from self-sown seed have withstood the winter in the open field, where there was no semblance of protection. During the coming winter a covering of dry cornstalks from the plots bearing sweet corn will be used over a portion of the area devoted to phloxes, and where an abundance of volunteer seedlings have established themselves since the last hoeing.

In 1901 the variety known under the trade name of *Phlox Drummondii* var. *cuspidata* was grown for purposes of crossing, and some

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* Cyclopedia of American Horticulture.

† The English Flower Garden, 1889, page 601.

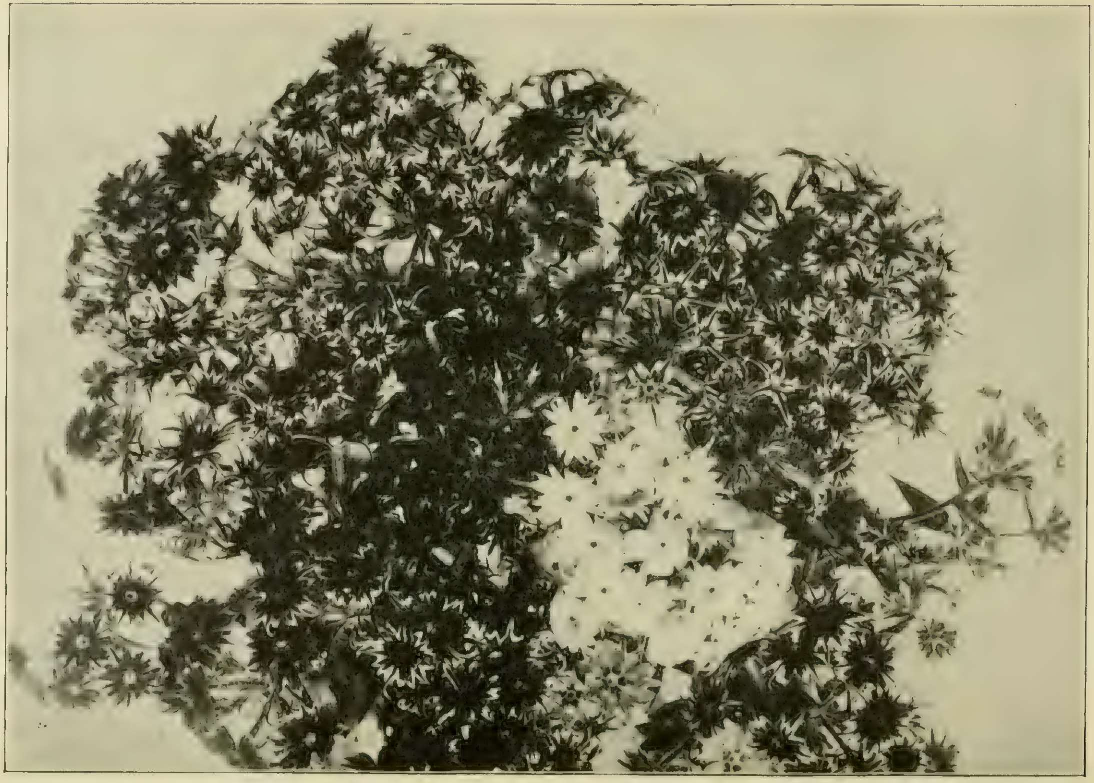

PLATE VIII.

Fringed Phloxes. A view, looking from above, of a bouquet of Drummond Phlox, showing various fringed and starry forms of flowers.

of the results were shown in Plate VI. of the report for last year. A very much larger number of variations have appeared the present season, some of which are particularly rich in both outline and coloration. Instead of the long, slender, single tip to each petal, as shown in the variety known among phlox growers as the "Quedlinberg or Star phlox," these often have a finely cut margin that is suggestive of the celebrated fringed gentian. One of the variations has been a pure white, with the delicate margin above mentioned. It has not yet been demonstrated that these types can be fixed by isolation of the plants so that fertilization within its own variation will be secured. Single plants may be multiplied by cuttings, and with care and time it is hoped that certain of the more desirable of the fringed types may become reasonably stable.

Plate VIII. shows some of the forms of the fringed phloxes as grouped loosely in a bouquet, the photograph having been taken from above. Near the center is a spray of pure white, and the effect is that of some of the mort attractive "Starworts" (*Stellaria*), "Starry Campion" (*Silene*) and other members of the pink family. Above and to the left of these are some with a rich, solid maroon, and because of their dark color they are nearly lost from sight in the picture. Others nearby have a dark center and a light border, and by this means the starry outline is well shown. A plain engraving cannot more than barely suggest the effects of these clusters of blossoms. There are fifteen or more distinct types, between which there is a decided difference as to form and color.

DATURA HYBRIDS.

Datura is a small genus, of about twelve species, native to the warmer portions of the globe. In our State there are two kinds, and these grow as weeds in rich, moist soil, under common names, as "Stramonium," "Jamestown," or "Jimson Weed," and "Thorn-apple." In this locality the two species *Datura Stramonium* L. and *Datura Tatula* L. are often in nearly equal numbers, and this, together with the fact that the chief difference is in the color of the stem, leaf-stalk and flowers, led to a testing of the seeds of some of these plants. Ripening, but still unopened, pods were gathered last autumn of *D. Tatula*, quickly recognized by the prevailing purple in stem, leaf and flower, and of *D. Stramonium*, which has white flowers and the other parts of a uniform green. As a result of these sowings it was ascertained that, in some instances, as high as fifteen per cent. of the seedlings were of the species other than the one bearing the pod that produced the seeds.

This led to a further study of these two species, and while in the greenhouse the large, tubular flowers were easily, and generally, self-pollenized—the anthers maturing and discharging their contents before the corolla had opened—it was found that the two species crossed artifically with ease.

Early the past spring, in the Station greenhouse, reciprocal pollenations were made between *Datura Tatula* L. and *Datura Stramonium* L. and well-developed seed obtained. Both species were readily fertilized with the ornamental sort, *Datura meteloides* DC., but several attempts to fertilize *D. meteloides* with the other two failed.

About forty plants representing *Datura Stramonium,* fertilized by *Datura Tatula,* and six of which *Datura Tatula* was the pistillate parent, were started in the Station greenhouse and transplanted to the Experiment Area (Plot IV., Series II.) July 11th. More of the crossed seeds were sown in the same plot July 14th. From those of *D. Stramonium* upon *D. Tatula* eighteen plants were obtained, and over seventy of *D. Tatula* upon *D. Stramonium.*

Those who are familiar with the two parent species can observe a difference in habit in these hybrids, but the untrained eye would not be likely to detect anything to separate them from the purple species (*D. Tatula*). In other words, it does not matter in what way the union took place, whether *D. Tatula* upon *D. Stramonium* or the reverse, the offspring have all taken the purple color of the *D. Tatula* parent, and none of them retain the green stems and leaves and white blossoms of the *D. Stramonium.*

The crossing needs to be more extensive before any conclusions as to the results obtained can be safely drawn. It would seem that, were it not for the very general self-fertilization prevalent in these two species, they would soon be blended into one hybrid at the loss of the green *D. Stramonium.*

These large, "heavy-scented" flowers are not apparently favorites with any of our insects, whatever may be the facts in Asia, the probable home of *D. Stramonium,* and in tropical America, where *D. Tatula* is reported as being native.

It remains to see what the second generation of the hybrids may be, for then it may be found that the green form is restored. A further study of the species may reveal before-undetected characteristics that may assist in a rational study of the hybrids.

Datura Meteloides DC.

At the same time that the above experiments were in progress hybridizing was under way with *D. Stramonium* and *D. meteloides*. This latter is one of the daturas native of New Mexico that is cultivated as an ornamental plant, the flowers being six inches or more long, tubular and white or pale violet, while the foliage has a delicately soft velvety appearance due to a fine coating of hairs. The stems and leaf stalks are a pale purple, and the white flowers show a tinge of the same color. The species represents a division of the genus that is distinct from the one to which *D. Tatula* and *D. Stramonium* belong.

Here it was found that the pollen is shed some time before the tube of the corolla develops into a bell, and it was necessary to remove the stamens several days before the time of blooming. In some instances success attended the application of the pollen of *D. meteloides* to the stigma of *D. Stramonium,* but all attempts to fertilize *D. meteloides* with the other two failed. The style of *D. meteloides* is fully twice the length of that of *D. Stramonium,* and this may account for the failure of pollen of the latter when applied to the stigma of *D. meteloides.*

Two pods fairly well supplied with seeds resulted from the *D. meteloides* upon *D. Stramonium,* and several seedlings were grown to fruitage in the open field during the past season. One set of these plants, all without much variation, have the green color of the *D. Stramonium,* while the seedlings from the other pod all have a uniform purple color that is even more intense than the parent *D. meteloides.* These hybrids as a whole were of the same general type as those between *D. Tatula* and *D. Stramonium* growing nearby. All seeds from *D. Tatula* fertilized with *D. meteloides* failed to germinate.

In a portion of Plot II., Series V., more crossing of *D. meteloides* upon *Stramonium* and *D. Tatula* was accomplished, and many attempts were made to work *D. Stramonium* and *D. Tatula* upon *D. meteloides,* but without success. One flower of *Datura fastuosa* L. (*D. cornucopia*) pollenized with *D. meteloides* produced a seed-bearing capsule.

EXPERIMENTS WITH WEEDS.

The weed belt has been continued for seven years without interference in any way—that is, plants have spread by roots, seeds have ripened and fallen, germinated and grown as they might be able in the fierce struggle with other kinds. It is needless to state that the ground has been occupied, and so to say two or more crops of plants have been made during the season, for some weeds are early in coming to the front and others delay until near the close of the season.

The following is the list of fourteen species that have been the most prominent during the year, arrayed in the order of their aggressiveness, the worst appearing at the head of the list and the least objectionable at the foot. Those weeds that were in the list for previous years, with their rank, are given in the table. Thus it is seen that in 1897 only five of the present list were then much in evidence, and, for example, the wild carrot was then twelfth on the list, while now it is second in rank.

	1897.	1893.	1899.	1900.	1901.	1902.	1903.
Rumex acetosella L. Sorrel..	....	7	4	3	1	1	1
Daucus Carota L. Wild carrot	12	....	....	4	5	2	2
Bromus racemosus L. Broom grass	....	....	....	....	2	3	3
Mililotus alba Lam. Sweet clover	....	....	....	12	10	10	4
Chrysanthemum Leucanthemum L. Ox-eye daisy	....	....	....	9	6	6	5
Polygonum Pennsylvanicum L. Smartweed	6	3	2	2	4	4	6
Aster paniculatus Lam (?) Aster	....	....	....	....	....	13	7
Convoloulus arvensis L. Bindweed	....	....	....	....	9	9	8
Taraxacum Taraxacum L. Dandelion	....	....	9	5	5	8	9
Silene noctiflora L. Catchfly	9	13	14	7	7	7	10
Abutilon Abutilon L. Velvetleaf	7	2	6	6	3	5	11
Oxalis stricta L. Oxalis	....	....	....	8	11	11	12
Ambrosia artemisiæfolia L. Ragweed	3	5	1	1	14	12	13
Rudbeckia hirta L. Yellow daisy	....	....	....	....	13	14	14

Other conspicuous species of weeds were:

Plantago Rugelii L.	Plantain.
Barbarea Barbarea (L.)	Yellow rocket.
Chenopodium album L.	Lamb's quarters
Rumex crispus L.	Dock.
Arctium Lappa L.	Burdock.
Panicum sanguinale L.	Crab grass.
Aster sp.	Aster.
Hibiscus Trionum L.	Hibiscus.
Polygonum Convolvulus L.	Bindwood.
Acalypha Virginica L.	Mercury.
Ixophorus glaucus (L.)	Fox-tail.
Amarantus retroflexus L.	Pigwood.
Tragapogon pratensis L.	Salsify.
Tragapogon porrifolius L.	Salsify.

Various clovers (*Trifolium ripens, T. hybridium, T. pratense*) and the seedling grape and cherry still hold on against the weeds.

Chickweed (*Alsine media* L.) and low spear grass (*Poa annua* L.) were unusually abundant upon the Experiment Area this season.

Plantago media L. was observed upon the College Campus, and seems to be new to the State.

Galensoga.

The genus Galensoga is a small one, the members of which are natives of warm, temperate and tropical America. Heller[*] lists two species and one variety, and Mohr[†] mentions but one, which is *Galensoga parviflora* Car., the same as the one that is in New Jersey, and of it he observes: "Becoming a troublesome weed."

The species are all annuals, and in some respects resemble the stick seeds (Bidens), but without the hooked or barbed seed-coats. They are likewise close akin to the fleabanes (Erigeron) and many other members of the great composite family of which the thistles and sunflowers are familiar representatives. The galensogas are in bad company, for the family to which it belongs is one abounding in weeds.

The species, specimens of which have been sent in for name and methods for eradication from time to time, is a rapid grower and a quite leafy plant, as the engraving (Plate IX., Fig. 1) well shows. It is especially fond of a rich soil and a fair amount of shade, these facts making the galensoga partial to the dooryard and any flower-bed that is neglected for a comparatively short time.

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[*] Catalogue of North American Plants, North of Mexico, 1900.

[†] Plant Life of Alabama, 1901.

It is, as before stated, an annual, and needs to come from seed each season. With this in mind it is evident that, by keeping the intruder from going to seed, the trouble will be lessened. The writer has sometimes seen a gardener keeping the galensoga faithfully out of the garden, while not far away it was seeding abundantly in a piece of waste land. It does not root deeply, and the plants are easily destroyed, but a long wet spell, with somewhat of inattention, are sufficient for the weed to come boldly into evidence and quickly mature its seeds.

It will, perhaps, be a sort of comfort to the persons who are troubled with it in New Jersey to know that their friends and relatives in Massachusetts or Alabama or Oregon are not out of reach of this intruder, that has come up, in some unknown way, from a warm, distant country, and find, to our discomfort, a congenial abiding place among our better plants.

The Black Night-Shade.

There seems to have been an unusual amount of the black night-shade the present season, a fact that may be traced in large part to the wet weather of the year. The weed in question is one of the poisonous members of the family that furnishes us some of our leading truck crops, as potatoes, tomatoes, eggplants and red peppers, while among its ornamental members are petunias and matrimony vine. The whole family is made up of plants that are most abundant in the tropical countries, and with rank-scented herbage.

Within the genus Solanum the black night-shade is closely related to the bitter-sweet and is a first cousin to the horse-nettle and the Texas-nettle, so that it is akin to some of our worst of weeds. It is called the black night-shade (*Solanum nigrum* L.) because of the dark color of the berries when mature.

One correspondent writes, under date of September 23d, 1903: "I found after cutting some millet and going over the whole field that there is deadly night-shade from one end to the other, enough I should say, to destroy all the livestock in the State. Is the night-shade poisonous to cattle when dry? Will it be necessary to plow this field up and cultivate it for a year or two before growing any more grass on it? Does the night-shade live over—that is, does the

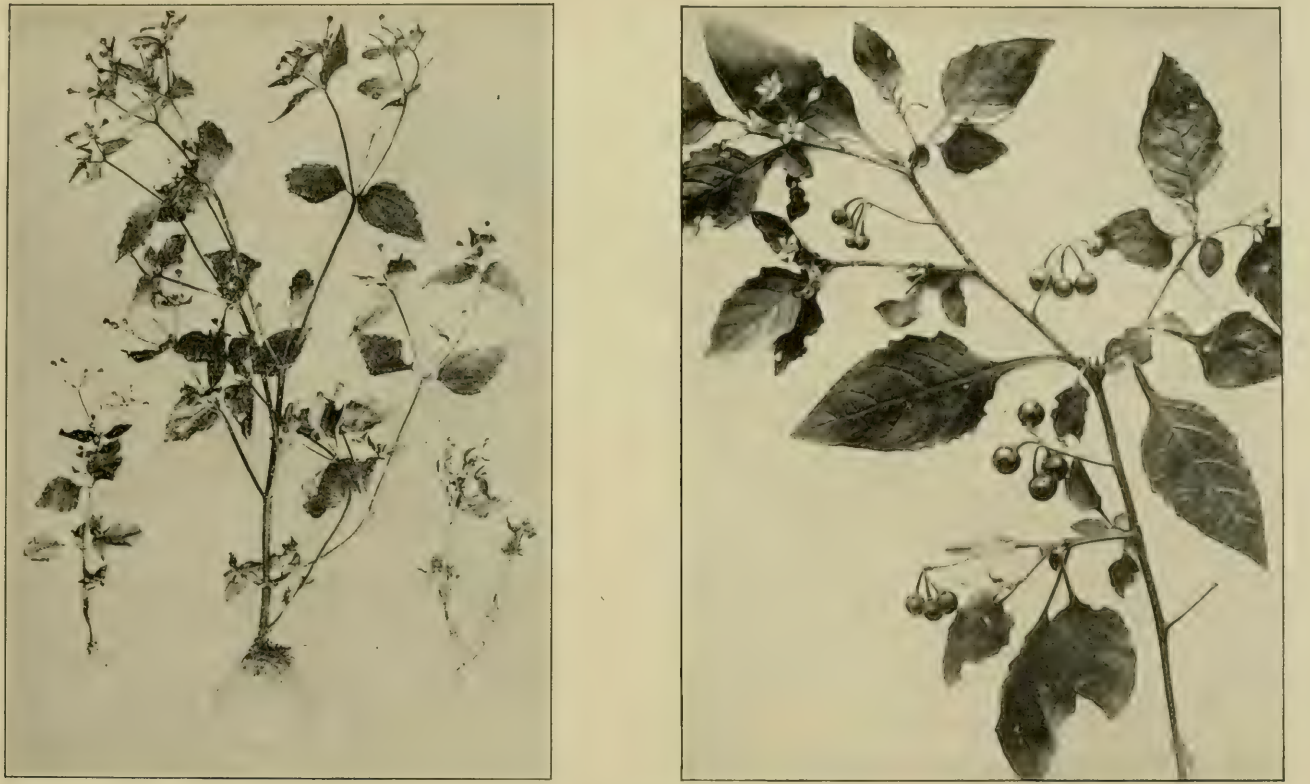

PLATE IX.

Weeds. The Galensoga is shown on the left, and Black Nightshade upon the right.

plant or root live over winter or does it come each year from the seed? The field, I am quite sure, has never had any in it before this season."

The fact that the pest in question is the *Solanum nigrum*, determined by specimens which were sent, upon request, to the Experiment Station, and that it is an annual plant, helped somewhat to solve the problem of eradication. The stock of plants for any year comes from seeds that have reached the soil in one or another of many ways. It is possible that in the instance before us the seeds came in with the millet, as is true with many kinds of weeds when they make their first appearance in a neighborhood. The weed may have been growing for years in some out of the way place nearby, and the seeds becoming scattered through the field awaited the conditions favorable for their growth. It scarcely need be said that the first step in the eradication is the destruction of all plants before they have time to mature seed either by cultivating the infested land or pulling out the night-shade by the roots. This method should give satisfactory results if continued for a few years until the seeds of the former seasons are disposed of, provided new seeds are not brought in by winds, animals or some by man as he sows his crop seeds.

The question of the poisonous nature of the weed is put very clearly by one correspondent, namely, "Will you please let me know if a small quantity of the night-shade should get mixed in with hay in the cutting would it be dangerous to feed it to cattle?" The whole plant contains the narcotic poisonous principle solanine, and for that reason it should not be fed to livestock. Just how much of the dried night-shade a grown animal can eat without ill effects is a matter that is very difficult to determine. Professor V. K. Chesnut,* as an authority upon the subject, states that "cattle seldom eat the plant, but a few cases of poisoning are recorded for calves, sheep, goats and swine," and again† he states: "The amount of poison present in any part of this plant varies with the conditions of growth. The more musky-odored are the most poisonous. The characteristic symptoms are about the same in man and animals. They are stupefaction, staggering, loss of speech, feeling and consciousness; cramps and sometimes convulsions. The pupil of the eye is generally dilated.

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*Preliminary Catalogue of Plants Poisonous to Stock, Report of the Bureau of Animal Industry, U. S. Dept of Agric., 1898.

†Thirty Poisonous Plants, Farmers' Bulletin, No. 86, U S Dept. of Agric., 1898.

Death is due to a paralysis of the lungs, but fortunately but few cases are fatal."

The general appearance of the black night-shade is to be obtained from Fig. 2 in Plate IX.

Slime-Molds Upon Crop Plants.

There is a group of organisms that, in the latest systems of classification, lies very close to the line separating plants and animals, namely, the Myxomycetes or Slime-Molds. In their growing condition the members of this group are soft like jelly, and capable of movement, from which the common name slime is derived. After this amœboid stage is passed the slime changes into a very different condition, in which the spores are produced. It is on account of the method of reproduction that the slime-molds are generally considered as fungi.

In germination the contents of many spores unite to form the slime, often masses of considerable size, which lives ordinarily in moist, shady places, as under rotting logs and decaying leaves in the wood-lot. When the time comes for the stage of reproduction to be assumed the jelly-like masses often creep into the light and upon the upper side of logs, stumps and other objects. Such kinds of slime-molds do not feed upon living plants, and their presence upon growing leaves and stems only means that they accept what may be in their path.

Every little while specimens of these slime-molds are received at the Experiment Station, sometimes with questions that suggest alarm upon the part of the correspondents. The last box of these strange plants exhibited samples of strawberry leaves that were covered with a species kindly determined by Professor MacBride as *Diachea leucopodia* (Bull.), who says of it in his book:* "A very beautiful species; not uncommon in the Eastern States; rare west of the Mississippi. This species, as the Diacheas, generally affects fallen sticks and leaves in orchards and forests, and even spreads bodily over the foliage and stems of living plants."

That the general reader may be further acquainted with this peculiar plant, the engraving is presented (Plate X., left hand), which shows a portion of a strawberry leaf as bearing the sporiferous form of this slime-mold.

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* The North American Slime-Molds, pages 134-135.

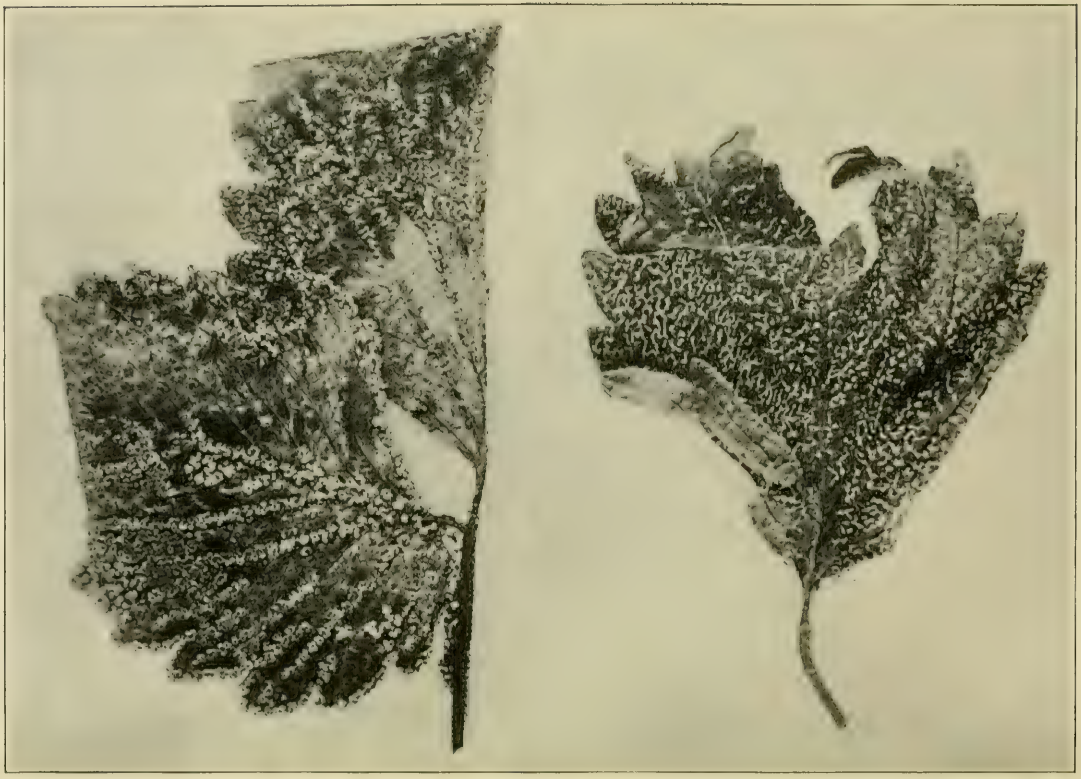

PLATE X.

Slime Molds. A Diachea is shown at the left, and Physarum at the right; both upon Strawberry Leaves.

There are some members of the same group of plants that penetrate the tissue of living plants, and there propagate as parasites, and often produce malformations in the host. Of such are the club-root of the cabbage, turnip and allied plants, and often become quite destructive to crop plants. This subject has been considered at length, and the results have appeared in previous annual reports and Bulletin 98* of this department.

A somewhat similar species of slime-mold has been demonstrated by Professor Toumey † as causing the grown-gall upon peach, almond apple and other orchard fruit trees, and to which he gave the botanical name of *Dendrophagus globosus* Tou.

A second species of slime-mold that has been sent to the Experiment Station is shown in Plate X. (right hand). This was also sent to Dr. MacBride, who determined it to be *Physarum cinereum* Batsch., and of it he writes: "It occurs not infrequently on the leaves, stems and flowers of various herbaceous plants, by no means infrequently here [Iowa] on the leaves, etc., of strawberry plants. I suppose it finds sustenance on the decayed organic matter offered in the way of manure, and in this way only can it effect the welfare of the cultivated plant." The delicate nature of this mold can scarcely be shown in the photo-engraving, but something of the ashen-gray spore sacs can be seen covering the veins of the leaf.

Broom-Rape, a Weed Upon Greenhouse Tomatoes.

During last winter, or, more accurately, in the early spring, the experiment tomatoes in the greenhouse became seriously affected with the broom-rape (*Orobanche ramosa* L.). Some of the tomato plants had a yellow, sickly appearance some time before the parasite pushed its dark-olive tips above ground, and by the time the broom-rape was in full bloom the supporting tomato plant had ceased to grow, and, of course, did not mature any fruit. So abundant was this parasitic plant that it materially interfered with the experiments and was therefore, even though handsome and interestingly peculiar, a real greenhouse weed of the sort that is not easy to keep from doing injury, because its work is much under the cover of the soil.

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*Club-Root of Cabbage and Its Allies, December 9th, 1893.

† An Inquiry Into the Cause and Nature of the Crown-Gall, J. W. Toumey, Bulletin 33, Arizona Experiment Station, April 13th, 1900.

In the previous year a coleus plant was thus infested by the broom-rape, and a picture of the infested plant and its parasite was given in the last report; and the year before one tomato plant in the field was similarly affected. The seeds produced in the greenhouse by the specimen of broom-rape upon the coleus are probably responsible for the outbreak of the trouble upon the tomatoes the following season. The seeds are small and almost like dust in lightness.

THE ASPARAGUS RUST.

Observations as to the prevalence of the asparagus rust have been made from time to time upon the asparagus fields in the vicinity of the Experiment Station and by correspondence with those most interested in the industry throughout the State. Through the kindness of botanists and horticulturists in several other experiment stations, some additional facts have been obtained.

It will be gathered from the extracts that follow that generally there has been less of the rust this season than for the past few years, and the decrease may be attributed to the greater rainfall and consequent better conditions for a vigorous growth of brush.

Mr. J. G. Whitall, of Woodbury, New Jersey, under date of October 19th, reports for Southern New Jersey as follows: "The rust is not so bad on asparagus the present season as it has been in former years; in many cases where beds have been properly cared for they are still green and thrifty; where neglected they show more or less of the rust. Beds of some of the older varieties are brown and dead, and have been so for some time. The crop this spring was fair, but ran largely to cull grass. The price was good."

Mr. J. S. Collins, of Moorestown, New Jersey, under date of October 31st, writes: "We sprayed this season six times (not as many as last year). It shows some rust, mostly on the small leaves or limbs on under parts, but the bed has a green look and might be said looks well. I hope it may do well another year."

For the central part of the State, Mr. Charles Tindall, of New Monmouth, reports upon October 3d: "We find that the same conditions exist in regard to the production this year as last—that the least rust in the fall, with favorable climatic conditions in the spring, we have an increase in the amount produced. We have practically no rust this fall in our cutting beds in this section, and most of the seedlings are free from it, with the exception of some that have not been properly cared for.

"While the climatic conditions and abundance of rainfall have had a tendency to give the plant strength to resist the disease, yet I feel encouraged to think that in a few years the rust will disappear entirely."

Mr. W. J. Morse, for Vermont, writes, under date of November 4th: "No specimens of this rust have been sent us this season, and we are unable to find any in the gardens around Burlington. Professor Stuart, our horticulturist, tells me that he has not seen any this year. The season here has been such that we have had very little trouble from fungi this year. The dry spring—no rain from the 1st of April until about June 10th—checked most such things, and the weather following was remarkably favorable for vigorous growth of strong, healthy plants." A week later the Professor kindly added that a bad case of the rust had just been reported to the Station authorities.

For Massachusetts, Dr. G. E. Stone writes: "The present season in this State has been much like the preceding, namely, it has been unusually cold, and there has been considerable rainfall. Previous to June vegetation suffered much from drouth. From June on, however, rain has been abundant. The rust has not been troublesome, and there has been much less than any year since it made its appearance.

"In looking over the College beds a few days ago (October 2d) we found, after considerable search, one or two small pustules containing teleutospores. Last year the rust was not perceptible on this bed until November, and undoubtedly we will not get very much on the bed this year until October or November.

"A number of beds in the Connecticut valley were examined by us September 2d, and no traces of rust could be found on any of the beds, although during our worst season of drouth, a few years ago, these beds for once showed a mixed stage of the rust, namely, teleuto and uredo, as early as August 25th.

"In the eastern part of the State, where rust has during some seasons appeared early and been common, the beds have been more free from rust this season than since the first outbreak. A large number of beds, examined by us September 5th, were looking remarkably green, and tolerably free from infection. On the whole, the last two seasons have not been especially favorable for rust, and beds are showing a tendency to regain their old-time vigor.

"There are reasons for thinking the rust will actually become less common the next few years, and that the first outbreak will have proven the most severe. The most intelligent growers are now willing to admit that a little clay or slit in the soil renders infection less pronounced. Some attempt has been made to plant the so-called "rust-proof" varieties. We have also found rust on these varieties."

Dr. G. P. Clinton reports for Connecticut as follows: "I do not believe that asparagus rust has been as abundant this year as last. We have had no complaints, and I have found it only once."

Professor Stewart sends the following report for New York: "Concerning asparagus rust in New York State, I have to say that, on Long Island, asparagus rust is less destructive than at any time since its first appearance, in 1896. Some fields are slightly injured by it, but in the majority of the fields the damage done is inappreciable. It is also less destructive than usual in other parts of New York. Since June 7th the rainfall has been abundant throughout the season."

For Pennsylvania, Professor Buckhout reports: "The season has been wet throughout, and the growth of asparagus, after spring cutting stopped, very profuse and rampant. I went over our bed about October 7th, not presuming to make a thorough examination, and found no rust at all. A few days later others found a few infested stems only, and reported that they had gathered it all. Certainly it has not increased, presumably even lost a little over last year.

"We have done no spraying, and have cut very heavily from our bed. A small bed in my garden has not as yet shown any rust at all."

Professor J. B. S. Norton writes: "The rust is quite abundant in Maryland, although some fields are entirely free from it. The rust was apparently not so bad this year as last. Captain R. S. Emory, of Chestertown, Md., a prominent horticulturist and one thoroughly familiar with all classes of economic and scientific work, showed me last week (October 20th) an asparagus patch which was affected with the rust, but was still quite green, while adjoining patches were almost dead. He said it was kept up by cultivation and fertilizers.

"Some of our Eastern Shore asparagus growers have been quite successful in using power sprayers very frequently during the season after cutting."

Professor William B. Alwood, of the Virginia Experiment Station, reports: "I have not observed this rust anywhere in this vicinity, except as noted last year in the gardens here at the College. We did not notice the rust until late in the summer, and soon as the plants were fairly mature we cut them off. We picked up every stem with great care, carried them off the gardens and burned them. This year we have not noticed a particle of rust on our plantation, but I am of the opinion that a minute examination would reveal some slight occurrence of this trouble."

Professor John L. Sheldon sends the following for West Virginia: "Asparagus is not grown in West Virginia to any considerable extent, but so far as my observations go the beds infested with the rust have been considerably weakened. The damage seems to be worse where *Darluca filum* accompanies the rust."

Professor A. D. Selby, of the Ohio Experiment Station, writes: "I can add little to previous reports. The rust has been sent to the Station from Hamilton county and from one or more additional counties within previously defined limits. Asparagus growers appear to look upon the rust more and more as a regular accompaniment of this culture. Methods of avoidance, rather than spray treatments, have been chiefly employed so far as reports to the Station indicate."

Professor B. O. Longyear, from Michigan, sends the following: "I have had only two plots of asparagus under observation during the present season; consequently cannot give any very careful points in regard to the rust. Conditions here have been very favorable for a vigorous and continuous growth of the plant due to the excessive rainfall. In both of the plots under observation the rust is present, but does not seem to be doing as much damage as in the ordinarily dry season. Whether this will hold true in all parts of the State or not I am unable to state, as the two plots mentioned are both in the vicinity of the Agricultural College. No remedies have been used on either of the plots mentioned. In the smaller plot the disease was almost entirely absent last season, which was also an unusually wet one, but was present to a considerable extent in the larger one, which was quite severe in both cases in previous seasons."

Dr. T. J. Burrill reports for Illinois as follows: "So far as I am informed the situation in Illinois in this matter is just about as it was last year when reported to you. The number of infected places are certainly as great as they then were, though in some instances diseased beds have been destroyed. I do not know of any instance in which the fungus has been eradicated by any less heroic measures than the entire destruction of the plantation, though it is certain that the disease has not made the progress in places where it was introduced that was anticipated. Neither has it, upon the whole, been so damaging as it appeared to be when it first gained possession. Infected plantations are still kept in some places, and have made profitable returns without any direct treatment. In some other cases the use of Bordeaux mixture seems to be keeping it down."

Professor Albert Dickens, of the Kansas Experiment Station, sends the following report: "The rust has never caused any serious loss in Kansas fields, though it has been noted quite frequently. The fields which have come under my observation are apparently free from the disease. The College bed has been in good condition the last three years; some rust noted in 1901, but fair crops have been cut each year since. We have practiced burning the tops each fall as soon as dry, breaking down and burning with as little handling as possible. There are a number of large fields near here, and quite an area along the river near Topeka and Kansas City. All seem to be in good condition and have been healthy and productive the last few years."

Professor Shaw, of Oklahoma, sends the following: "The asparagus rust has not come under my observation in Oklahoma or Indian Territories, nor have any reports of its occurrence in this region reached me."

Professor L. R. Waldron reports for North Dakota: "The College bed was covered with straw in the fall of 1902 to a depth of eight inches after the asparagus had been burned. The fall was wet, and as a consequence some fermentation was set up in the straw. In the spring more fermentation took place and after the straw had partially dried it was burned, but it did not entirely burn off. The rust appeared in the bed to slight extent in July, but did not kill the asparagus until about the middle or latter part of August. In a large bed near the College no treatment was made, and the bed of asparagus was only partially burned during the preceding season. The rust appeared in this in July to a very destructive extent, in a more noticeable degree than in the College bed that had the straw application. Whether the straw was instrumental in checking it I cannot say. In general, the disease has caused more damage to asparagus beds in this State this past season than any preceding season."

Professor Aven Nelson writes as follows for Wyoming: "It is my pleasure to report again that no asparagus rust has come to my attention during the past season."

Professor Ralph E. Smith, of the California Experiment Station, writes: "In regard to the conditions of the asparagus rust in this State I would say that at present the disease is spreading rapidly and all the large districts are affected. It seems to have been here for at least two or three years, working from the south to the north. In the section about Los Angeles the disease is very bad, both on account of having been there for some time and also because of the local conditions. The rust shows in this State an absolute dependence upon atmospheric moisture, and in this southern district there is much more dampness than in many other parts of the State. In the sections where asparagus is grown for canners the disease is very bad in some parts and present in almost all. About San José, where there is considerable acreage, the rust appears to have been working for at least two years, while at the northern end of the district, at Sacramento, it has evidently arrived this year for the first time, although in the latter place the tops are now almost all dead. At Bouldin Island, where the Hickmott Company controls some 2,000 acres of asparagus, the rust arrived last year, doing considerable damage, and is now going on worse than ever. This point is intermediate between San José and Sacramento. There are several thousand acres of asparagus in the island district at the confluence of the Sacramento and San Joaquin rivers, and this is all becoming affected with the rust, so that altogether it may be said that the disease is now present in all the asparagus-growing sections of the State. There is no doubt that the industry will be very seriously affected, or perhaps exterminated, if we do not find some practical method of overcoming the disease."

Asparagus Rust on the College Farm.

Examinations of the four plots of asparagus at the College Farm were made almost weekly during the autumn months. The first signs of infection were observed upon October 1st, but the rust did not seem to increase during the month, and on the 1st of November it was still scarce, while the brush had a remarkably good growth and was of a healthy, dark-green color.

The final inspection was made upon November 3d, and the percentage of rust upon the several varieties was as follows: "Palmetto" and "Argenteuil," only a trace; "Mammoth," "Elmira," "Columbian," "Colossal," "Brunswick" and "Cross-bred," each 10 per cent.

Last year the percentages were 25 for the first two and 75 for the others, and the year before it was 20 and 50 per cent. for the same sets of asparagus.

EXPERIMENTS WITH SEEDS AND SEEDLINGS.

Since the greenhouse was established, in 1900, some experiments each season have been made with the germination of seeds. During the first winter the various dodders and other similar parasites were studied, and an outline of this work, with two page plates, appeared in the Report for 1901. Last year attention was paid to the germination of crossed corn, and particularly the white seedlings that are known as albinos and seem to be associated with close fertilization.

During the past winter tests in germination were made with squash and similar seeds. This is, in part, a continuation of experiments that were started some years ago and published elsewhere,* and from which some facts are here produced. For testing the time required for germination of various cucurbitaceous (squash-like) seeds, a shallow box, 20 by 36 inches, was filled with rich soil and placed upon a table in the laboratory, and the different kinds of seeds and the rate of germination are shown in the following table:

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* Bulletins of Botanical Department Iowa Agricultural College, 1886, pages 30–35, and 1888, pages 20–26.

Rapidity of Germination.

Number.	KIND OF SEED PLANTED APRIL 9.	April 13.	April 14.	April 15.	April 16.	April 17.	April 18.	April 19.	April 20.	April 21.
1	Peerless watermelon	....	....	....	....	....	....	....	....	1
2	Boss watermelon	....	....	....	....	....	....	....	....	2
3	Citron	....	....	....	....	....	....	....	1	1
4	Early Russian cucumber	....	6	7	7	9	9	9	9	9
5	Improved long green cucumber	5	7	8	9	9	9	9	9	9
6	Gherkin	....	....	1	1	1	2	2	5	5
7	Dishcloth gourd	....	....	....	....	1	1	1	2	2
8	Nest-egg gourd	....	3	6	6	6	6	6	6	6
9	Dipper gourd	....	....	1	1	1	1	1	2	2
10	Cantaloupe muskmelon	....	....	2	4	6	6	7	7	7
11	Early Jenny Lind muskmelon	....	....	1	3	5	5	5	5	5
12	Nutmeg muskmelon	....	....	....	3	5	5	5	5	5
13	Winter crook-neck squash	....	....	3	4	5	6	6	6	6
14	Yellow-bush scallop squash	....	....	2	3	5	5	6	6	6
15	Hubbard squash	....	....	....	....	3	4	4	4	4
16	Hercules club gourd	....	....	....	....	....	....	....	....	....

The number of seeds was not uniform, as the large seeds were six for each kind, while of smaller sizes there was room for a dozen; therefore this is no test for vitality.

"The prompt response of the two cucumbers proper (Nos. 4 and 5) to the conditions furnished is marked. The watermelon seeds start slowly, if at all, under conditions seemingly satisfactory for the development of cucumber seedlings. The 'gherkin,' 'dishcloth gourd' and the 'dipper' are all nearly alike as to time. The 'nest-egg,' 'cantaloupe,' 'nutmeg' and all the squashes were slow, but sure. By the 18th, nine days after sowing, these rows had a fine showing of plants. The last and slowest of all was the 'Hercules Club' gourd, which, with its large, thick-coated seeds, did not make any appearance above the soil until the 28th of the month, or nineteen days after the sowing was made."

One of the chief points of study in this experiment was that of the removal of the thick seed-coats with which this class of seeds is provided. The most satisfactory results were obtained by placing the seeds between folds of blotting paper kept constantly moist. The seed-coats open at the end that was attached to the fruit—that is, the "root" end—by the elongation of the primary root, which pushes out, and, if possible, at once turns downward. At the same time there is a lateral growth from the base of the stem, which now consists of a short zone of tissue separating the base of the root from the two large seed-leaves that still remain within the seed-coats. This side growth consists of a cushion of tough cells, without vessels of any kind, developed upon the lower side of the stem and spreading out upon the upper and inner end of the lower half of the seed-coat.

This curious contrivance was first described by M. Flahault in 1877,[*] and it did not escape the keen eyes of Mr. Darwin, who gave it the name of "peg," and writes of it as follows:[†] "A heel or peg is developed on one side of the summit of the radicle or base of the hypocotyl, and this holds down the lower half of the seed-coats (the radicle being fixed in the ground), whilst the continued growth of the arched hypocotyl forces upward the upper half and tears asunder the seed-coats at one end and the cotyledons are then easily withdrawn."

As the peg develops it exposes a thick layer of fine, branching hairs upon the side close to the inner coat, while the opposite or free surface is smooth and without hairs.

"Each of the outgrowths from the epidermal layer of cells of the lower surface of the peg is irregular in outline, often tortuous, frequently abounding with small, disc-like projections, and the extremities are club-shaped. The basal half of each hair is thick-walled and seemingly empty, while the younger and exposed irregularly-branching part is filled with granular protoplasm, which in its disposition and contents is identical with similar structures where glandular exudation takes place. This hairy surface of the peg becomes closely fastened to the inner coat, and as this coat is in close contact with the thick outer covering throughout its whole surface, it is easy to see that the peg in question has a firm attachment to the seed-coats as a whole. As soon as this peg has been developed and its attachment to the coat is secured, the seedling is in readiness to extricate itself from the thick and now worthless covering. The root continues to strike downward into the soil for support and anchorage, and produces lateral roots at many points on its way. The portion of stem above the peg, and between it and the cotyledons, which until now has been in comparative repose, begins to elongate. As the increase in length of this part of the stem continues, a loop is necessarily produced, the sharpest curve of which is outward from the seed-coats and upward from the peg. By continuing this elongation it is evident that so long as the peg holds on to the seed-coats the only part to give away is the cotyledon, and, as the result, these seed-coats are slowly and effectually withdrawn from their coats. Before this desired end is reached the loops may extend an inch or more above the seed-coats. In short, the soil is broken by the sharply-folded upper end of this loop, and not long after this the cotyledons are lifted out of the earth and raised to an upright position in the air and sunshine."

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[*] Bull. Soc. Bot. de France, XXIV., page 201.

[†] The Power of Movement in Plants, pages 102-105.

The most advantageous position for the seed in which to remove its seed-coats in germination has been sought for by extended trials. When, for example, the seed is planted with its root end downward, the seed-leaves, in many cases, will come above ground still within their coats, and such plants are sadly handicapped for further growth. A worse position is when the root end of the seed is placed upward, and particularly so when this end is near the surface of the ground. With these the young root must elongate upward for some distance, until it can make a turn downward, and this may bring it into the free air, when its moist, delicate substance is derived, and the seedling frequently perishes. The striving of these ill-placed seeds for a root-hold in the earth are sometimes painfully amusing. Seeds, when placed edgewise in the soil, must develop very wide pegs, that they may thereby catch and hold the edges of both halves of the seed-coats, and there may be a failure in this and the seed-coats are brought to the surface upon the cotyledons.

"There is a very practical bearing of these experiments upon the work of seed sowing. It is a common practice among gardeners and farmers to prepare the 'hills' for the melons, squashes and other members of the gourd family, and then, with the thumb and finger, thrust the seeds endwise or edgewise into the soil. Should the seed be placed with the root end uppermost, and close to the surface of the soil, there is very little hope of a plant therefrom ever getting a good start. When the reverse is true, and the root end points directly downward, the plantlet experiences great difficulty in developing a peg that will remove the seed-coats. It has also been shown that seeds placed edgewise are not in a favorable position for the peg to act. It needs to be very wide, and then only the ends have an opportunity to hold back the vertical edges of the two halves of the seed-coat. The conclusion is evident that the best conditions are secured when the seed is placed upon one of its broad faces. This position is the one such seeds would take when left to fall naturally upon a level surface. Therefore, the 'hills' could be prepared as in the ordinary way, the seeds sown upon the leveled surface and afterwards covered with the required depth of soil. These conclusions are abundantly sustained by actual tests in the garden."

The seed-coats of some of the cucurbitaceous plants are provided with starch in the outer coat. All those of the "Hubbard" squash type, for example, are thus starch-bearing. The only place in the whole seed where this reserve food substance is stored is in the outer layers of cells of the two broad surfaces of the large white seed. When such seeds are placed in a solution of iodine the seeds take on a dark-blue color, because of this starch. In Plate XI. (upper third) is shown a number of kinds of squash seeds in pairs. The seed upon the left in each pair had been placed in iodine before the picture was taken, and the darker seeds are the ones that were colored blue from the presence of starch. All except the last four show starch in the outer coat. This placing of food substance upon the outside of a seed, and apparently out of reach of the embryo within, seems like a lunch provided for a person in a place in an overcoat that is not within reach. Some experiments have been made upon these starch-bearing seeds, the results of which are given below, but the end of the work has not been reached.

Experiments with Mutilated Squash Seeds.

"Hubbard" squash seeds were used, and the plan of the experiment was as follows:

Set *A*—Five seeds untreated.
" *B*— " " one-half (cotyledon end) removed.
" *C*— " " shell removed.
" *D*— " " root-end of shell removed.
" *E*— " " tip (cotyledon end) removed.
" *F*— " " starch coat removed.

The first planting was made February 2d, and, aside from mutilation, all the seeds were subjected to normal conditions. The first signs of germination were noted nine days later—February 11th—when the conditions of the several sets were as follows:

In Set A, one seedling breaking through.
" " C, " " " "
" " F, five seedlings " "

No signs of germination in Sets B, D or E.

A second seedling appeared in Set A and another in Set B.

The above series was duplicated in a second planting, February 6th, and eight days later—February 14th—four seedlings were breaking through in Set *A*, one in Set *E*, and three in Set *F*. A few days later the fifth untreated seed had germinated in Set *A*, and a fourth in Set *F*. No plants developed in Sets B, C or D.

The two trial plantings would suggest that the removal of the outer starch-coat from the squash shell has little if any effect upon the rate of germination or upon the vigor of the seedling plant.

On January 30th five scraped and five untreated squash seeds were planted in pots and subjected to the same conditions. On February 7th—eight days later—it was noted that there was a slight difference in the rate of germination in favor of the untreated seeds; four of which were out of the soil, erect and with cotyledons beginning to expand. The fifth seedling had just broken through the soil, and the cotyledons of the five seedlings from scraped seeds were not quite out of the soil. On February 12th there was some contrast between the two sets, owing to the "scraped" set being noticeably longer than the untreated, a difference which was to be seen up to the third week, when the plants were thrown away.

In another experiment a portion of the seed-coat was removed from one side of each of five squash seeds. The mutilated seeds were planted in pots February 6th, and at the same time five untreated squash seeds were planted in like manner; all of the mutilated seeds failed to germinate.

Seedlings of Martynias or Unicorn-Plant.

In connection with the crossing of martynias a study was made of the seeds and seedlings. The seeds themselves are very irregular in shape, due to being packed closely in the narrow cavities of the horn-like capsule, and, while nearly black, glisten at certain places upon their warty surface. The seeds are very slow and irregular in germination, and new seedlings will continue to appear in a seed-box for weeks and even months after the first have come to the surface.

One of the points of special interest in this connection is the presence of the heel or peg as has been mentioned for the squashes and allied plants. The peg has the same position upon the hypoctyl as in the squashes, and evidently performs the same function, namely, the removal of the hard, thick seed-coats from the cotyledons that would otherwise interfere with the development of the seedlings. A series of seedlings of the *Martynia Louisiana* Will. is shown in Plate XI. (middle third), giving the various stages of growth from a seed, with the root tips only extending beyond the hard, dark, rough seed-coat to a plant with the first pair of true leaves widespread. A study of these photographic reproductions will indicate the part the conspicuous peg plays in the germination of this plant. Purposely the empty seed-coats have been removed from some of the seedlings that the peg may be the better seen. In the three plants at the right, for example, the position of the empty seed-coats, as held by the peg, is quite naturally represented.

This provision for the removal of the hard, thick seed-coats from the martynia plantlets has been noted by Nobbe* with figure, and by Darwin in his book previously quoted. It only needs to be added that the importance of the peg is abundantly shown by any seedling that from any of several reasons has not been fortunate enough to leave the seed-coats attached to the peg, but instead bear them aloft upon the cotyledons, which are thereby prevented from expanding or the plumule from taking on its natural development.

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* Handbuch der Samenkunde, 1876, page 215.

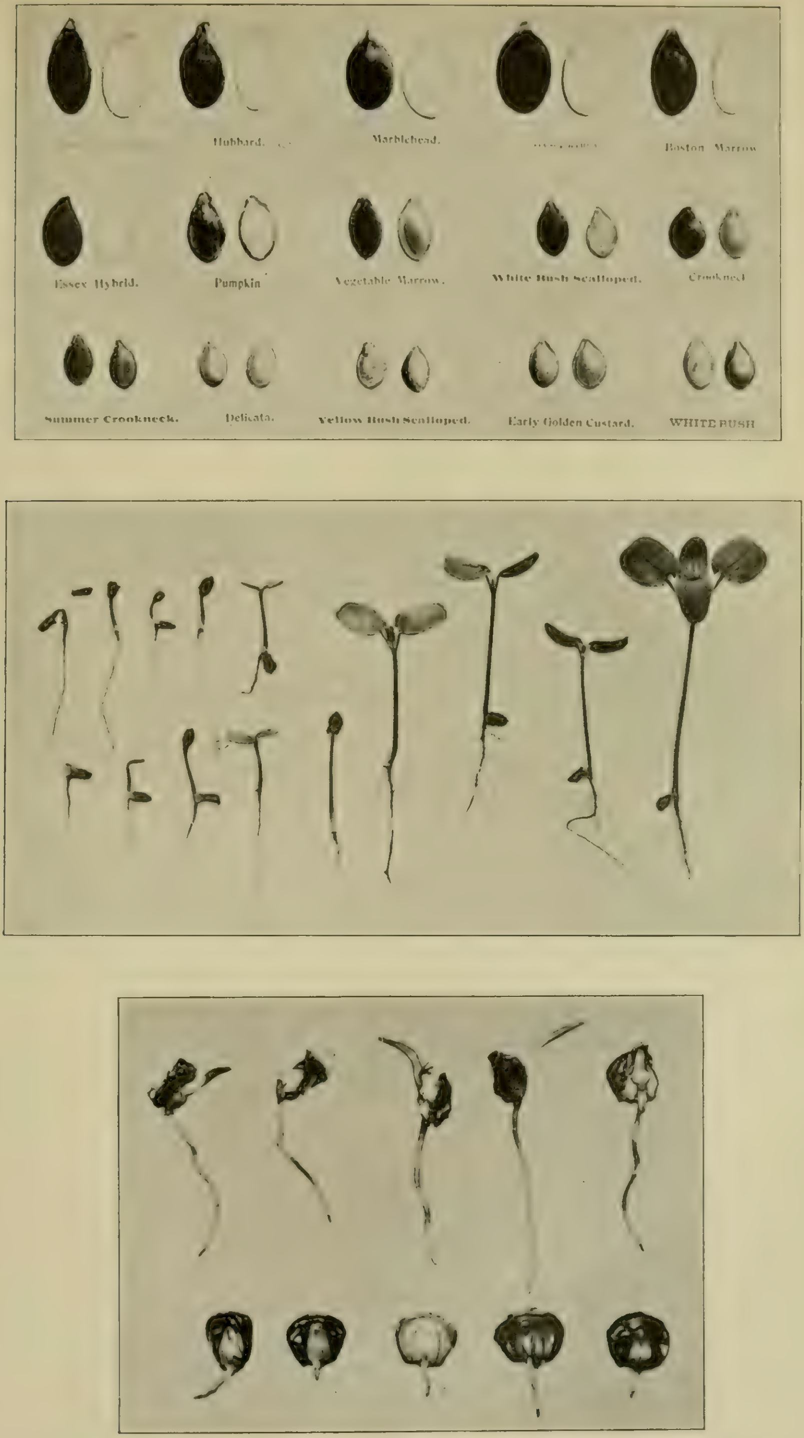
Hubbard.
Marblehead.
Boston Marrow
Essex Hybrid.
Pumpkin
Vegetable Marrow.
White Bush Scalloped.
Crookneck
Summer Crookneck.
Delicata.
Yellow Bush Scalloped.
Early Golden Custard.
WHITE BUSH

PLATE XI.

Seeds and Seedlings. *A*, Squash Seeds indicating starch in the seed coats. *B*, Seedlings of Martynia showing peg. *C*, Mutilated Corn as affecting germination.

Mutilated Corn.

A test was made of removing a portion of the starch from grains of corn. This was done by first soaking the grains until they were soft, when the edges were easily cut away, leaving only the embryo and the closely-adhering portion of the food material. Such mutilated grains, when placed under favorable conditions of warmth and moisture, produced the first root and young stem with greater rapidity than corresponding grains that had been left whole. Plate XI. (lower third) shows five seedlings of sweet corn forty-eight hours after the endosperm had been removed, while in the lower row are grains from the same lot as the first, and treated in the same way, excepting that they had been left uncut. It is seen that the upper row has produced three times as much root capacity and young stems of considerable length. In the lower row the stem growth is only slight.

This greater growth of the mutilated grains seems due to easier access of water, and the consequent more rapid formation of the solution of substances necessary for initial growth. In the long run the seeds, robbed of their substance, will suffer from lack of parental food.

THE POWDERY MILDEWS.*

The powdery mildews, of which there are at least thirty-five kinds in the United States, are recognized as forming a white powder upon the surface of the infested plant. The lilac is a shrub so common and generally attacked that it may be taken as an instance of showing the appearance of the mildews in question. After midsummer the previously smooth, clean, dark-green foliage takes on a gray color, as if coated with a whitish road dust.

The mildew consists of microscopic threads, that grow along close to the surface of the leaf, and send up short, upright stalks, bearing minute spores, which, in large numbers, give the appearance of flour dusted upon the plant. Later in the season the white coating may be replaced, in large part, by a second form of spore-production, which is usually brown. Thus there are two sorts of spores, one being nearly white, in mass, and produced rapidly in summer for the spread of the mildew, and a second form that matures slowly, perhaps requiring months for this, and remains over winter before they start into growth.

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* Mildew is an old English word that has a similar form in the German Mehlthau, meaning *meal-dew*. One can easily imagine the fine meal or flour having fallen in minute quantity upon the affected herbage.

Expert rose-growers can detect the rose mildew in the greenhouse possibly before it is at all apparent to the eye. There is a peculiar odor to this group of fungi that is not met with elsewhere, and a leaf badly affected with the summer form gives off this odor so strongly that, when it is held close to the nose, the diagnosis is unquestioned.

Several of our serious plant diseases belong among these mildews, and in the following paragraphs they are considered somewhat at length.

Their Classification.—The kinds of powdery mildews are not numerous. According to Salmon there are only forty-nine species and eleven well-marked varieties known in all the world. The differences between the kinds are chiefly microscopic, and belong mainly to the penthicia and their contents. In other words, the mildews, as they first appear from the germinating spore, usually in early summer, are all very much alike, and a student of the subject does not feel that the species or genus can be certainly determined without the so-called "winter fruit." The case is somewhat similar to the classification of apples or pears, peaches or blackberries, without their fruit. The vegetative portion of the mildew corresponds to the stems and leaves of the trees or shrubs, the summer spores to the many buds, and with only these the kind cannot be definitely known. Some plants bear quite generally mildews which fail to produce the winter spores, and in all such instances it is uncertain what species of mildew is present. An interesting case is the European grape mildew, which was named *Oidium Tuckeri*, by J. M. Berkeley, in England over a half a century ago (1845). Since that time the mildew has been very destructive to the grape industry throughout Europe, Asia and the United States, but not until 1892 were the penthicia found associated with *Odium Tuckeri* in the vineyards of France. In the meantime a mildew was found upon grape vines here in America that produced the "winter fruit," but the question of the identity of the American and European form was not generally admitted, and the conclusion was only reached by finding both kinds of spores upon the grape in the home of the Oidium.

To bring the matter closer home, the writer has a matrimony vine upon his house piazza, that mildews each late autumn, but after the most diligent search I have failed to find the least sign of the "winter fruit." If one should ask for the history of the species here represented in the rapidly-spreading summer form, no positive answer could be given. There is a species (*Microsphæra Mougeotii* Lev.) upon the same host that is as yet recorded only for Europe. It is seen that it is the reversed case of the *Oidium Tuckeri*, above mentioned, and it remains to find the "winter fruit," or, failing in this, to call it by the name of the last species mentioned, with a question mark added, or name it *Oidium Lycii* tentatively.

The classification of the species, as previously stated, is founded chiefly upon the perithecia, their appendages and contents. First, certain species, along with other characteristics, have but one spore sac in the penthicium, thus making two primary groups of the mildews. Second, the appendages are unbranched, branched, sharp-pointed or with curved tips. By means of these few characters the species are separated into six genera, as shown by the following key.

Spore sac in penthicium one—

Appendages, branched	*Podosphæra.*
Appendages, unbranched	*Sphærotheca.*

Spore sacs in penthicium more than one—

Appendages, curved	*Uncinula.*
Appendages, branched	*Microsphæra.*
Appendages, unbranched	*Erysiphe.*
Appendages, needle-shaped	*Phyllactinia.*

These six genera are represented in the United States by the following number of species:

	Species.		Varieties.
Podosphæra	3	and	1
Sphærotheca	5	"	1
Uncinula	9		...
Microsphæra	5	and	4
Erysphe	6		...
Phyllactinia	1		...
Total	29		6

After the genus has been determined, which is a very easy matter as a general rule, another set of characters is considered, and here the greatest care is required. Let us take the mildew of the lilac for a consideration of the specific marks. For these a compound microscope is required that is provided with a measurer (micrometer), by means of which the average size of the penthicia is determined—66 to 135 micromillimetres* in diameter. The number of the spore sacs within the penthicium—3 to 8—is determined and their shape globose and size 42–70 by 32–50u. Next the spores, 4–8 in each sac, are measured (18–23 by 10–12u), and then attention is directed to the number, position and size of the appendages or holdfasts of the penthicium, particular account being taken of the unusually complex forking at the tips. When specimens agree with the description suggested in the above outline they are considered as belonging to the genus Microsphæra, and the species *Microsphæra Alni* (Wallr.). The generic name Microsphæra means *little sphere*, as suggested by the shape of the minute penthicia, and the specific addition Alni is from Alnus, the Latin for alder, upon various species of which the mildew is common.

It might be thought an easy matter to determine the species directly from a known list of the plants upon which it has been found. This method might answer the purpose, provided that only one kind of mildew infested any grown host. For example, the oaks are generally attacked by the *Microsphæra Alni* (Wallr.), but also by three other species, and two varieties of the one in question. The only safe way is to give each specimen of mildew a searching microscopic examination.

Their Development.—Unlike the rusts, smuts and various deeply-seated blights, the powdery mildews, as stated before, are superficial and their growth is easily watched. Starting at a point where the spore has fallen, the mildew is first noticed as a speck, and this rapidly enlarges to the size of a dime, retaining its circular form unless meeting with the rim of another advancing colony when irregular shapes are produced. The spreading may continue until the whole infested area, whether leaf or stem, is coated over. It is frequently easy to see without a glass the radiating lines which converge here and there in the points of original attack. In like manner the spore cases may be seen formed along the main threads or "spokes" and giving to the coating of mildew something of a starry appearance. Some of these characteristics may be seen in the representations in Plate XII.

The rate with which the mildew develops depends upon the kind of mildew, of host and the surroundings of heat and moisture. Upon

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*A micromillimeter designated by the Greek letter u—mew—is one twenty-five housandth ($\frac{1}{25000}$) of an inch.

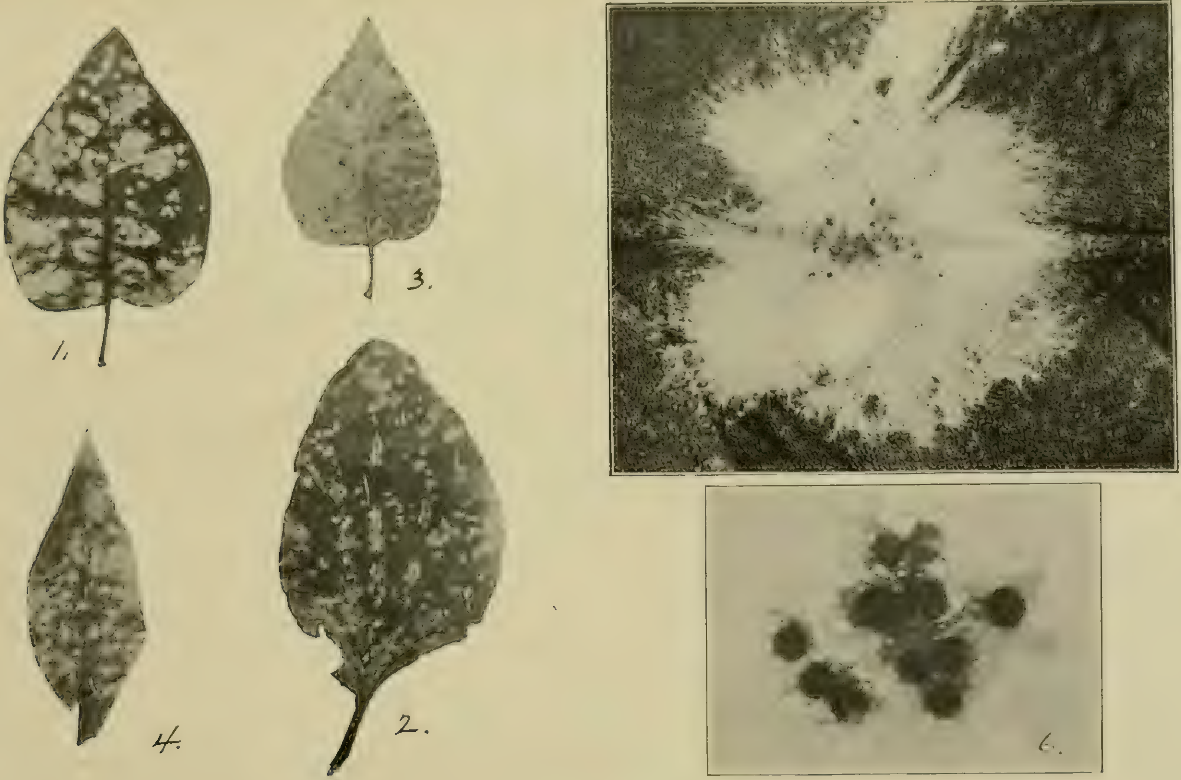

PLATE XII.
Views of Powdery Mildews.

certain of the most susceptible of the tender roses the growth is so rapid that the young leaves are nearly covered with the mildew in a day or two after it is once started. Some rose-growers associate its appearance with an improper ventilation of the greenhouse, and claim that it can be produced with certainty by drafts of outside air striking the plants when all the other conditions are favorable for the spread of the mildew. However this may be, the fact must not be lost from sight that it is a germ disease and the source of contagion consists in spores that fall upon the surface of the susceptible plant. Spores, like seeds, require certain conditions for their germination, and when these obtain they grow and sometimes with wonderful rapidity.

Soon after the spore has germinated it sends suckers into the host whereby the mildew plant derives its nourishment and is able to spread its cobwebby threads along the surface. Shortly it begins to produce upright branches which bear spores at their tips. The time from the germination of the spore and the beginning of an infection spot to the production of a crop of spores is measured by only a very few days, and this helps to explain the rapidity with which the fungus covers a whole plant or fills a rose-house with the mildew.

The production of the spores, as above mentioned, continues indefinitely and in numbers beyond computation. They are the "summer spores," and designed for rapid germination during the growing season. A second form of spore is very different from this and arises slowly within the perithicia before mentioned. These are called the "winter spores," and are designed to pass the winter as such and germinate the following spring or summer. The spore-case arises from a union of threads, and, after producing a nearly spherical shell, the spores are developed in sacs within. Situated as they are within the sacs, which in turn are inclosed by the thick, brown wall of the perithicium, the spores are protected from the destructive elements, like peas in their pods, the pods being in, for example, a tightly-covered basket.

Upon some plants only the summer form of spore is found, but as a rule the perithicia are formed late in the season, and by the time the leaf is ready to fall the white of the early appearance of the mildew is replaced by the brown of the perithicia, which in some instances are so numerous as to almost cover the whole infested surface of the host. This thick, brown coating of the leaf in autumn is suggested in the picture of the phlox leaf at 4, in Plate XII.

Their Distribution.—The powdery mildews are all parasitic, and their abundance in any locality depends largely upon the character of the flora. Certain groups of plants seem to be entirely exempt from their attacks, and where these abound the mildews naturally are less numerous than where the susceptible plants prevail. Thus no mildews are met with upon the ferns and their allies. None prey upon the pines and related cone-bearing plants. In like manner the long-leaved plants, like rushes, sedges, lillies and orchids are exempt, excepting the single family of grasses, and here but one species of mildew is found. Therefore, the pine forests and the bogs, where mosses, ferns and grass-like plants make up the vegetation, are practically free from mildews. But in localities where the plants are of the sorts other than those just mentioned, the mildews may be expected. According to Professor Salmon,* in his recent exhaustive study of the group, "the headquarters of the mildews are in the North Temperate zone, as they occur in the greatest numbers in the United States and parts of Europe." It should be borne in mind that it is only within a short time that mildews have been carefully studied, and in the vicinity of old botanical centers they are better known than elsewhere. In other words, the mildew flora of Europe is much better known than of Africa or Asia. With us the subject has been more advanced in New England than the Dakotas or Texas. In short, there are areas in the United States where the mildew hunter has not been, and therefore it is too soon to dwell at length upon the distribution of these fungi in our country from the economic standpoint.

Some species have been found upon but a single host. Thus, for example, the *Podosphæra biuncinata* C. & P. is a strictly American species, described in 1872, and met with only upon the leaves of the witch hazel (*Hamamelis Virginiana*). A glance at the herbarium shows specimens from the following States: Vermont, Massachusetts, New York, Indiana, Illinois, Wisconsin, North Carolina, Alabama. It goes without saying that the range of this mildew depends upon the distribution of a single species, unless future search should determine some other host for it. Illustrating the same point, and of more economic importance, is one of the mildews of the apple. *Podosphæra leucotricha* (E. & E.) Sal., which is confined to our common apple (*Pyrus malus*) and another species (*Pyrus Sieboldi*) and is found in Europe, Asia, Japan and the United States. *Sphærotheca phytoptophila* K. & S. is a recently-discovered American species, described in 1888, which has been found only upon the hackberry (*Celtis occidentalis*) and only associated with the distortions of the branches due a gall mite (*Phytoptus*). This limitation contrasts greatly with *Erysiphe Cichoracearum* DC., which is a world-wide species, described with its present scientific name in 1805, thriving upon a long list of hosts. For example, in the United States it has been found upon 105 species of plants. It is this species that mildews the ragweeds, asters and goldenrods in the fields and neglected land, and the dahlia, sunflower and cucumber among cultivated plants. The *Microsphæra Alni* (Wallr.) is an old species, with a very wide range of hosts in sixteen different families of plants, usually, however, upon trees or shrubs. This species has been mentioned in the opening paragraph as the mildew of the lilac. It is quite generally upon the nut trees, birches and has a special liking for the dogwoods and viburnums. Having such a long list of hosts, it is not surprising that it is met with in Europe from Italy to Norway, as it is with us from Maine to California and Manitoba to the Gulf.

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*A Monograph of the Erysiphacea, by E. S. Salmon. Memoirs Torrey Botanical Club, New York, 1900.

Powdery Mildews of the Orchard.

The leading powdery mildews of the orchard are *Sphærotheca pannosa* Wallr., which grows upon the peach, and *Podosphæra oxyacanthæ* (DC.) DBy. upon apple, cherry and plum. The mildew of the peach is not very common, but has been abundant the present season. It appears upon the young twigs and their younger leaves, covering all with a thick, white coat, while the leaves are prevented from making their normal growth and are sometimes distorted, suggesting the work of the leaf-curl parasite, which, however, is a very different fungus. The peach mildew is found upon only a few species of plants, the roses being the chief of these, and the subject will be considered again in this paper.

The mildew of the apple, plum and cherry is, in appearance, similar to the one of the peach, but very much more common and destructive. It is most frequently met with upon the cherry, the young leaves of which in autumn are often whitened with it and more or less dwarfed and distorted. Young trees seem more disposed to the mildew than older ones, and nursery stock is sometimes severly injured by the pest.

Many experiments have been made with various solutions, and none are more effective than the standard Bordeaux mixture.

This mildew has wider range of hosts than the one upon the peach, and may be found upon various species of spireas and hawthorns, while the quince is occasionally affected. All of these plants are closely related to the apple, cherry and plum.

Powdery Mildews of the Fruit Garden.

The leading mildew of the small fruits is *Sphærotheca Mors-Uvæ* (Schw.) that preys upon the gooseberry. It differs somewhat in habit of growth from the others because it forms a thick, brownish covering upon the canes, leafstalks and the fruit. While it is found upon several of our native species as growing in the wild state, it is unusually destructive to European cultivated varieties, and has been a serious check to the extensive cultivation of these latter sorts in America. Professor Salmon, in a recent letter, stated that this mildew is upon the increase in Ireland and becoming a serious pest. Very good results have, however, attained the use of fungicides, and among them that of sulphide of potassium has proved satisfactory. This is a simple solution, easy and cheaply made and may be employed without the risk that obtains with some others.

The powdery mildew of the grape (*Uncinula necator* Schw.) is found upon several of the wild species and also infests the American ivy, a near relative of the grape. While this mildew may appear upon the fruit and canes, it is usually confined to the leaves, and there is not conspicuous, particularly upon the woolly sorts. In America this fungus is not very serious, but in Europe it has been among the worst enemies of the grape, and the amount of its destruction in a single season is truly vast. With the present knowledge of methods of treatment with fungicides there is no longer occasion for alarm.

The strawberry is occasionally infested with a mildew *Spæenthica Humuli* (DC.) var. *fuliginea* (Sachkt.), but as yet it has not become serious.

Powdery Mildews of the Vegetable Garden.

The cucumber is sometimes troubled with a powdery mildew (*Erysiphe Cichoracearum* DC.), and the same species is occasionally met with upon the pumpkin. Garden peas, particularly the late sorts, are badly infested with *Erysiphe Polygoni* DC., a mildew of wide distribution and growing upon nearly sixty kinds of plants. Experiments show that it can be controlled by fungicides. The beans of various sorts usually escape from the attacks of this mildew.

Powdery Mildews of the Greenhouse.

The leading powdery mildew that makes trouble for the grower of plants under glass is the *Sphærotheca pannosa* Wallr., which quickly produces white patches upon the rose leaves. It is distributed throughout the world and upon many species of roses, the peach being the only other host plant, outside of the rose genus, thus far known to be infested by this mildew.

There is another species of mildew upon roses, namely, *Sphærotheca humuli* (DC.), and therefore there is much confusion between these two last-named kinds, because the determinations are carelessly made, without a study of the perithecia, which are often omitted in the development of the mildew.

The second species of mildew pestering the greenhouse plants is *Erysiphe Cichoracearum* DC., which thrives upon the cucumber and other plants of its family, and asters, dahlias, zinnias of the composite family, probably including the chrysanthemums. The last in an interesting case of the rank and destructive growth of the conidial, or summer form of the mildew, while the "winter fruit" is omitted. Until the latter perithecia can be found, the old name of *Oidium Chrysanthemum* Rabenh. will be retained to designate this pest. In a similar way, *Oidium leucoconium* Desm. was the name for the rose mildew until its final determination was made.

The mildew of the cucumber and the chrysanthemum (?) is very destructive to indoor phlox, and something of this host and its pest will be said under the head of "Remedies."

Powdery Mildews of the Field and Forest.

The field and forest encircle the plants that have not been mentioned elsewhere. Of the grains and grasses there is but one mildew that has yet been recorded, namely, *Erysiphe graminis* DC. This is frequently met with upon redtop, blue grass, oats, barley, wheat, etc., and should any new host for mildew be found among the grasses, it would most likely be infested with this same species. However, as before stated, the only safe way is to make a microscopic examination of the winter fruit and compare results with the descriptions of the various recorded species.

In a similar way, there is one species that is particularly fond of the members of the great sunflower family, and is, therefore, the mildew of a large list of our worst weeds. This is the *Erysiphe cichoracearum* DC., and may be generally seen whitening the foliage of sundry ragweeds, fleabanes, solidagos, asters, ironweeds and cockleburs. It is also often upon the verbenas of the field and the garden species as well, and the same way with the kinds of phlox, wild and cultivated. This mildew is among the worst, because there are so many wild plants that harbor it just outside of the garden fence, or even in the garden, when the latter is not kept free from weeds.

Another instance of the last-mentioned fact is in evidence with the mildew of garden peas, namely, *Erysiphe Polygoni* DC., which has many hosts among the most common of our weeds, as, for example, the various buttercups, meadow-rues, lupins, vetches, certain clovers, geraniums, evening primroses and columbines, besides several smartweeds. It is evidently a hard matter to keep such a species of mildew in subjection.

There are two species unlike the last-mentioned that chiefly infest the woody plants. Thus the *Phyllactinia corylea* (Pers.) is at home upon birches, alders, chestnuts, oaks, elms, hawthorns, maple, ash, catalpa, etc., and among vines the waxwork (*Celastrus*). The *Microscophæra Alni* (Wallr.) has a similar wide range of trees and shrubs, and when any of the hosts are introduced to the ornamental grounds the mildew does not leave it untouched.

The genus Uncinula has some well-marked species that are very limited in number of their hosts—one is upon maples, another upon basswood only, another upon the horsechestnuts and buckeyes, one upon mulberry only, one upon the vines, American ivy and grape, two others upon the hackberry only, and the most common species of all (*Uncinula Salicis* DC.) is limited to poplars and willows.

Remedies for the Powdery Mildews.

The powdery mildews were among the first economic fungi to be systematically combated by substances inimical to them.

Until 1880 sulphur was the substance that was used for this purpose and with good results, particularly for the mildew of the vine, then known as *Oidium Tuckeri*, and of the rose and other susceptible plants under glass. The sulphur was applied as a powder, dusted in various ways upon the plants, and by means of the fumes which slowly arose the mildew was checked in its growth or killed. The methods of application are many. Professor Maynard* uses "evaporated sulphur," as follows: "A small kerosene stove, with a thin, iron kettle was used, and the sulphur kept boiling two or three hours thrice each week, when the house was kept closed. Care must be taken that only enough heat is used to boil the sulphur and that it is not set on fire."

It is thought by many to be more convenient to apply the remedy as a spray, and for this purpose any of the standard fungicides may be employed. The Bordeaux mixture, while effective, is not to be recommended for indoor plants like roses, as it leaves a discoloration of lime that is objectionable.

During the past two winters the experiments with kerosene emulsion indicate that this compound is effective and at the same time does not leave any stain upon the treated plants. A statement of these results is given in a recent bulletin† from this department.

As an illustration of the susceptibility of the powdery mildews to the toxic effects of fungicides, the following experiment is cited: The plants involved in the trial consisted of twelve seedlings of the Drummond phlox, each in a separate flower-pot. Six of these, six plants in every way as nearly equal as possible to the other six, were subjected to treatment, while the duplicate half dozen were placed alongside and subjected to all surrounding conditions, excepting the single one, of the spraying the first six received.

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* Treatment of Mildews upon Plants Under Glass, Journal Mycology, Volume VI., pages 16-17, 1891.

† No. 157. Some of the Newer Fungicides, June, 1903.

A pound or so of copper turnings, used for various experiments where metallic copper is required, and kindly furnished by the Professor of Physics in the College, was placed in a large glass jar and covered with distilled water, a glass cap being fitted over the jar. From this jar the water was used for spraying the six plants at intervals of about one week, until the experiment terminated after two months.

It was observed that the long contorted strands of copper soon lost their native color and became dark in the water, but no apparent taste was imparted to the liquid. No chemical tests were used in the experiment. As the weeks passed there began to be a difference in the amount of the mildew upon the two sets of plants, the untreated ones becoming coated thickly with fungus. It should have been added among the conditions that the whole set of twelve plants were placed near the bed where the main experiments with the mildew were in progress, and there was no lack of spores for a rapid and thorough infection.

At the conclusion of the experiment two average plants from each of the lots of six were selected, and, after being placed in a row, with the sprayed two in alternation with the two untreated, a photograph was secured that is reproduced in the engraving (Plate XIII.), with, however, much loss of the striking effect as seen in the specimens themselves. In short the plants treated with the "copper water" were much less infested by the mildew, and as a consequence had a more healthful appearance and produced normal blooms, while the untreated plants were literally covered with the fungus, and the hope for blossoms practically passed.

The above facts are stated without any application of the theories of modern chemistry to account for them. This experiment calls to mind one made some years ago with the germination of spores, as recorded in the report for 1891, page 289.

The tests were with the spores of the common cherry rot (*Monilia fructigena* Pers.), which would germinate in two hours or less, and the following is reproduced as a partial explanation of the possible toxic action of the copper water when sprayed upon the phlox plants that were constantly subjected to inoculating spores of its favorite mildew:

"The substance tested was the ammoniacal carbonate of copper compound, and of various strengths, beginning with the strongest—

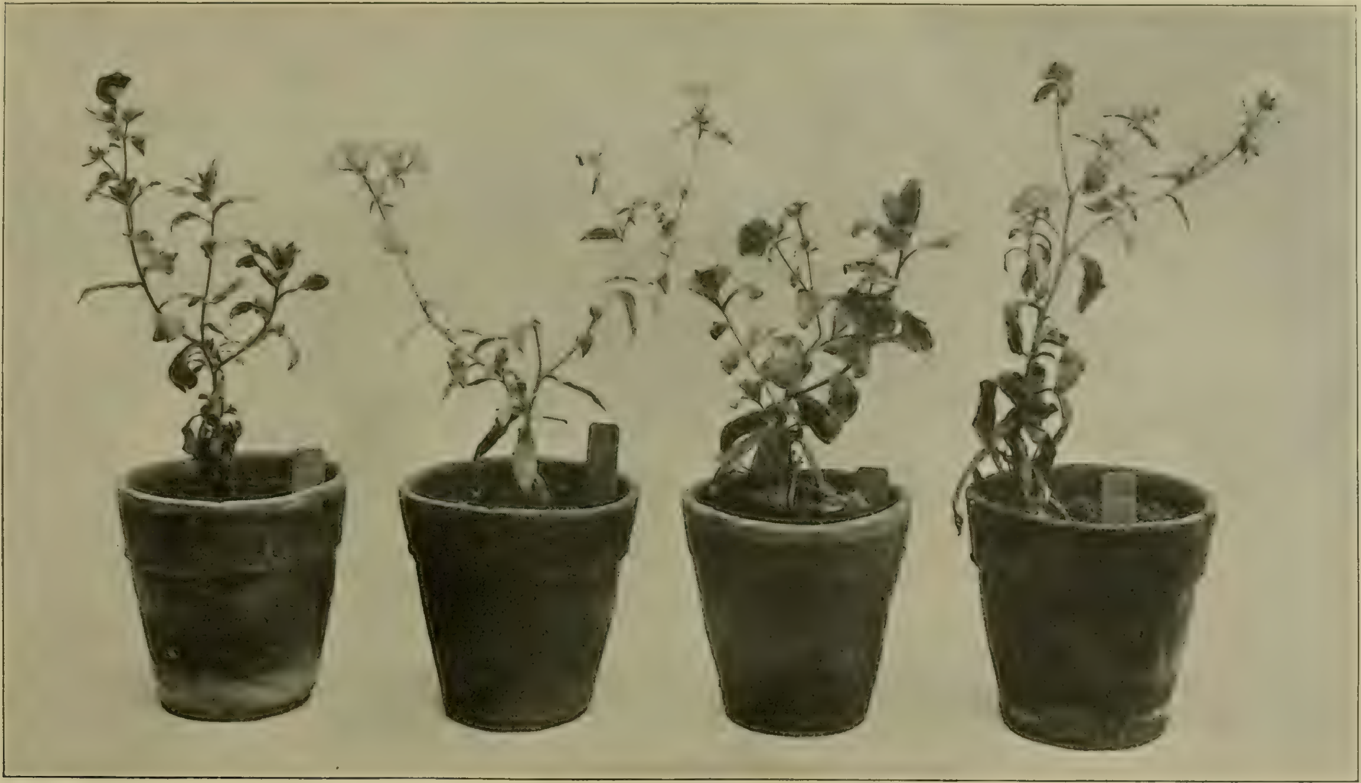

PLATE XIII.
Phlox Plants used for testing "Copper-water" for Powdery Mildew.

that is, three ounces of the carbonate of copper to one quart of ammonia. By this the spores were killed, as also by the half, fifth and twentieth strength. An extreme dilution was then substituted, namely, a one per cent. strength of the fungicide, as used for spraying grapes, etc.—that is, one part of the ordinary vineyard strength was added to ninety-nine of pure water, which gave a liquid that contained so little copper as to require a most delicate chemical test to detect its presence. In such a solution the spores would not germinate, but after several days, when the spores were washed five times and placed in pure water, they grew slowly. In order to carry the tests a step farther, slides with pit cells were arranged, with pure water in each, but into alternate ones a small bit of polished copper foil was dropped, the piece being in area equal to that of the lead at the end of a Faber pencil. That the presence of this minute amount of metallic copper should prevent the germination of the spores was surprising, and only after many trials was the fact accepted. In only one case in a score or more was any spores with the copper found with germ-tubes, and in this they had probably formed before the sowing was made. In no instance was there any failure of the spores to grow in the check-cells with pure water only. That there might be no chance of any oxide of copper or other soluble compound being present, the foil was thoroughly scoured and rubbed to a bright polish. After the bit of copper was removed and the water changed, the spores would sometimes germinate, the degree of activity depending somewhat upon the length of time they had been held in check.

"If now, in place of pure water in a fresh preparation, a percentage of cherry juice is added to the slide-well, the spores grow, the rate depending upon the amount of stimulating fluid added. A point could doubtless be reached at which the action of the nourishing fluid would just equal that of the copper, and the spore would remain alive and inactive indefinitely.

"While at first sight there does not seem to be any practical bearing for these results, upon a further consideration it may teach the truth that fungicides, as at present employed, are far stronger than they may need to be. If a bit of metallic copper in pure water will hold its own weight, or many times that of spores inactive, it seems likely that the time has come to try a weaker solution of copper.

"Since the above was written opportunity has offered to test the spores of a species of Fusarium and those of *Cercospora Apii* Fr., the celery blight, both of which germinate with remarkable rapidity in water. When surrounded with their congenial food—that is, an extract of the host plant—the rate over that of pure water is augmented many times. When copper is added to the water the spores fail to germinate, or, in short, the results are the same as those reported for monila.

"Similar experiments have been made with metallic zinc, but even when the spores were literally surrounded by the granulated metal they grew with vigor. A powdered form of metallic zinc was also used, and even in abundance had no retarding effect."

For the out-of-door mildews, particulary the *Sphærotheca mors-uvæ* (Schw.), there have been many trials made with a long list of substances. At the New York (Geneva) Experiment Station this pest has been under treatment for some years. The following is quoted from the Bulletin No. 161:* For three seasons Bordeaux mixture, lysol and formalin have been compared with potassium sulphide, the latter giving the best results in all three series. The recommendation is to use potassium sulphide, one ounce to two or three gallons of water, and the spraying should begin just as the gooseberry buds are opening and be continued at the usual intervals of ten days.

It is not unlikely that good results would obtain with the potassium sulphide upon garden phloxes or any other of the affected hosts for the powdery mildews.

In Plate XII., Fig. 1, is shown a lilac leaf with the mildew (*Microsphæra Alni*) in a young condition upon the upper side. The somewhat circular spots are so many developments from points of inoculation. Over some areas of the leaf the circles of spreading fungous threads have met with others, and a nearly uniform coating will in time result. This is particularly true of the left half of the leaf above the middle, while upon the right is a portion of the leaf with but few mildew patches, and a very small one may be distinguished like a star in an unaffected area of the leaf.

At 2 is a leaf of the ordinary dooryard plantain, showing, in young condition, the very common species *Erysiphe Cichoracearum* DC. as it develops upon the upper side of the leaf. It also illustrates the preference shown for the veins, as it is seen that the patches center along these lines, possibly because of the greater amount of moisture here met with upon the surface.

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* Treatment for Gooseberry Mildew, by C. P. Close, November, 1899.

The winter spores that form after the mildew has vegetated for a time are quite frequently upon the under side of the leaf, and in many instances only found then. Plate XII., Fig. 1, shows the under side of a leaf of garden phlox, upon which, as the leaves are ready to fall, the perithecia are in abundance, and may be seen as small, dark specks, the indistinctness being partly due to the surrounding brown threads that partially envelop the spore-cases. Sometimes the perithecia entirely coat over the surface of the leaf, and, as each of these cases contains many spores, it is no wonder that the mildew is kept over the winter and is ready to begin life anew when another season, with fresh foliage, is at hand.

An under side of a lilac leaf is shown at Fig. 3. This leaf was gathered some weeks later than the one shown in Fig. 1, and after the under surface had become evenly coated with the mildew threads and upon which the dark spore-cases formed. In the lilac the perithecia are less enveloped by brown threads and the minute dark spots are therefore more evident. Unfortunately the leaf is reduced below natural size, or else the perithecia containing the winter spores would be more clearly seen.

Below is given a preliminary list of the species of powdery mildews of cultivated plants, with the leading hosts under each. Following each host name is given the abbreviations of the States in which the plant has been recorded with the mildew upon it. The list of papers consulted follows at the close of this article.

I. PODOSPHÆRA. *Kunze* (1823).

1. *Podosphæra Oxyacanthæ* (DC.), De Bary.
        Erysiphe Oxycanthæ DC. (1807), as above, 1870.
    Pomaceæ, Cratægus Sp.—W. Va., Ind., Ill, Ala., Can.
    Pomaceæ, Malus Malus (L.)—Vt., Mo., Ala.
    Pomaceæ, Pyrus Cydonia L.—Ind.
    Drupaceæ, Prunus Cerasus L.—N. Y., N. J., O., Ind., Ill., Ala., Neb., Kan.
2. *Podosphæra leucotricha* (E. & E.) Salm.
        Spærotheca leucotricha E. & E., 1888, as above, 1900.
    Pomaceæ, Malus Malus (L.)—Vt., Mo.

II. SPHÆROTHECA. *Leveille* (1851).

3. *Sphærotheca Humuli* (DC.) Burr.
        Mucor Erysiphe Linn (1753). Erysiphe humuli DC. (1815), as above (1887).
    Moraceæ, Humulus Lupulus L.—Ala., Wyo., Cal.
4. *Sphærotheca Humuli* (DC.) Burr. *var fuliginea* (Schlecht) Salm.
        Alphitomorpha fuliginea Schlecht, 1819, as above, 1900.
    Rosaceæ, Fragaria cult.—N. Y.

5. *Sphærotheca pannosa* (Wallr.) Lev.
    - Alphitomorpha pannosa Wallr., 1819, as above, 1851.
    - Rosaceæ, Rose Sp.—O., Ind., Ill., Wis, Ia., Ala., Dak., Colo., Cal.
    - Drupaceæ, Prunus Persica S. & Z.—N. Y.
6. *Sphærotheca Mors-Uvæ* (Schw.) B. & C.
    - Erysiphe Mors-Uvæ Schw., 1834, as above, 1876.
    - Grossulariaceæ, Ribes Grossularia L.—Vt., N. Y., N. J., O., Can.

III. UNCINULA. *Leveille* (1851).

7. *Uncinula Salicis* (DC.) Wint.
    - Erysiphe Salicis DC., 1805, as above, 1884.
    - Salicaceæ, populus tremuloides L.—Vt., O., Ind., Ill., Wis., S. D., Mont.
    - Salicaceæ, Salix cordata Muhl.—Vt., O., Ill., Ind., S. D.
    - Salicaceæ Salix Sp.—Mass., N. Y., N. J., O., Ind, Ill., Wis., Minn., Ia., Dak., Wyo., Mont, Cal.
8. *Uncinula necator* (Schw.) Burr.
    - Erysiphe necator Schw., 1834, as above, 1892.
    - Vitaceæ, Parthenocissus (Ampelopsis) quinquifolia L.—Vt., N. J., W. Va., O., Ind., Ill., Wis., Ia., S. D., Neb., Kan., Can.
    - Vitaceæ, Vitis cordifolia Michx.—W. Va., Ind., Wis.
    - Vitaceæ, Vitis vinifera L.—Cal.
    - Vitaceæ, Vitis Sp.—Mass., N. Y., N. J., W. Va., O., Ind., Ill., Wis., Ia., Ala., Neb.
9. *Uncinula circinata* C. & P. (1872).
    - Aceraceæ, Acer saccharinum L.—Vt., N. J., O., Ind., Wis., Ia, Mo., Neb.
    - Aceraceæ, Acer saccharum March.—O., Ind., Ill.
10. *Uncinula macrospora* Peck. (1872).
    - Ulmaceæ, Ulmus Americana L.—Vt., O., Ind., Ill., Wis, Ia., Mo., S. C., Ala., S. D., Kan., Can.
11. *Uncinula flexuosa* Peck. (1872).
    - Hippocastanaceæ, Æsculus glabra Willd.—O., Ind., Mo., Miss.
    - Hippocastanaceæ, Æsculus Hippocastaneum L.—Vt., N. Y., Ind.
12. *Uncinula Clintonii* Peck. (1872).
    - Tiliaceæ, Tilia Americana L.—Vt., N. Y., Ind., Ill., Wis., Ia., Can.
13. *Uncinula geniculata* Ger. (1873).
    - Moraceæ, Morus rubra L.—N. Y., Ind., Ill., Mo., Ala.

IV. MICROSPHÆRA. *Leveille* (1851).

14. *Microsphæra Alni* (Wallr.) Salm.
    - Alphitomorpha panicillata var. alni Wallr. 1819, as above, 1900.
    - Juglandaceæ, Hicoria (Carya) alba (L.)—Ill., Mo., Miss.
    - Juglandaceæ, Juglans cinerea L.—Ill.
    - Juglandaceæ Juglans nigra L.—Ind., Ill., Miss.
    - Fagaceæ, Castanea dentata Marsh.—W. Va., O.
    - Fagaceæ, Castanea sativa Mill.—N. C.
    - Fagaceæ, Fagus Americana Sweet.—Vt., N. Y., W. Va., Ind, Ill., Wis., Ala.
    - Ulmaceæ, Ulmus Americana L.—Ill.

Platanaceæ, Platanus occidentalis L—Vt., O, Ill., Ind., Mo., Ala, Miss., Kan.
Cæsalpinaceæ, Gliditsia tricanthos (L.)—O., Ind., Ill., Ala., Miss.
Celastraceæ, Euonymus atropurpurea Jacq.—O., Ind., Ill., Mo., S. D., Neb.
Rhamnaceæ, Ceanothus Americana L.—Vt., Ill., Minn.
Oleaceæ, Syringia vulgaris L.—Vt., Mass., N. Y., O., Ind., Ill., Wis., Minn., Ia., Mo., Ala., Miss., S. D., Neb., Kan., Can.
Bignoniaceæ, Tecoma radicans (L)—Ind., Ala., Miss.
Caprifoliaceæ, Lonicera Tartarica L.—Vt., Wis.
Caprifoliaceæ, Viburnum dentatum L.—Ind, Wis.

15. *Microsphæra Alni* var. *Vaccinii* (Schw.) Salm.
Erysiphe vaccinii Schw, 1834, as above, 1900.
Bignoniaceæ, Catalpa Catalpa (L.)—N. J., W. Va., O, Ill., Mo.
Bignoniaceæ, Catalpa speciosa Ward.—Ill., Ia., Neb.

16. *Microsphæra Alni* var. *Extensa* (C. & P.) Salm.
Microsphæra extensa C. & P., 1872, as above, 1900.
Fagaceæ, Quercus alba L.—Vt., N. J., Ind., Ill., Wis.
Fagaceæ, Quercus rubra L.—Vt., O., Ind., Ill., Wis., Ia., Ala.

17. *Microsphæra Grossulariæ* (Wallr.) Lev.
Alphitomorpha penicellata var. grossulariæ Wallr., 1819, as above, 1857.
Grossulariaceæ, Ribes Sp.—Cal.

18. *Microsphæra diffusa* C. & P. (1872).
Caprifoliaceæ, Symphoricarpos Symphoricarpus (L)—Ind., Ill., Ia., Mo., Neb., Kan.

V. ERYSIPHE. *Hedwig* (1851).

19. *Erysiphe Polygoni* DC.
Mucor Erysiphe Linn., 1774, as above, 1805.
Magnoliaceæ, Liriodendron Tulipifera L.—N. Y., W. Va., O., Ind., Ill., Ala., Miss.
Papilionaceæ, Pisum sativum L.—Vt., Mass., N. Y., N. J., Ill., Ia., Mo., Ala., Miss., Cal.

20. *Erysiphe Cichoracearum* DC.
Mucor Erysiphe Leyss, 1783, as above, 1805
Polemoniaceæ, Phlox divaricata L.—Wis.
Polemoniaceæ, Phlox Drummondii Hook.—N. J., Wis.
Polemoniaceæ, Phlox paniculata L.—Ind., Ill., Wis.
Polemoniaceæ, Phlox Sp.—N. J., O., Ill., Ala., Can.
Cucurbitaceæ, Cucumis sativus L.—Vt.
Cucurbitaceæ, Cucurbita Pepo L.—N. Y.
Cichoriaceæ, Tragopogon porrifolius L.—Neb.
Compositæ, Dahlia variabilis Desf.—O.
Compositæ, Helianthus annuus L.—Ind., Ala., Neb., Mont.
Compositæ, Helianthus Sp.—O., Ill., Ala., Miss., Dak.
Compositæ, Zinnia elegans Jacq.—Ind.

21. *Erysiphe graminis* DC. (1815).
Gramineæ, Agrostis alba L.—Ia.
Gramineæ, Poa pratensis L.—Vt., W. Va., O., Ind., Wis, Ia., Mo., Miss. S. D., Kan., Wyo.

VI. PHYLLACTINIA. *Leveille* (1851).

22. *Phyllactinia corylea* (Pers.) Karst.
Sclerotium Erysiphe var. corylea Pers., 1801, as above, 1885.
Fagaceæ, Castanea dentata (Marsh.) W. Va., O.
Fagaceæ, Fagus Americana Sweet.—Vt, O., Ala., Wis.
Ulmaceæ, Ulmus Americana L.—Ill., S. C., Ala.
Magnoliaceæ, Liriodendron Tulipifera L.—Ind., Ill., Ala.
Celastraceæ, Celastrus scandens L.—Vt., Ind., Ill., Wis, S. D., Neb., Kan., Can.
Oleaceæ, Fraxinus Americana L.—Ind., Can.
Bignoniaceæ, Catalpa Catalpa (L.)—O., Ind., Ill.

The following is a preliminary list of the hosts of the powdery mildews selected from among the plants that are more or less under cultivation. The numeral following the name refers to the species of mildew in the preceding list of mildews:

Acer saccharinum L., 9.
Acer saccharum March, 9.
Æsculus glabra Willd., 11.
Æsculus Hippocastaneum L., 11.
Agrostis alba L., 21.
American Ivy, 8.
Ampelopsis quinquifolia Michx., 8.
Apple, 1, 2.
Ash, 22.
Aspen, 7.
Basswood, 12.
Beech, 14, 22.
Bittersweet, 22.
Black walnut, 14.
Buckeye, 11.
Burning Bush, 14.
Butternut, 14.
Buttonwood, 14.
Carya alba Nutt, 14.
Castanea dentata Marsh., 14, 22.
Castanea sativa Mill., 14.
Catalpa 15, 22.
Catalpa Catalpa (L.), 15, 22.
Catalpa speciosa Ward., 15.
Ceanothus Americana L., 14.
Celastrus scandens L., 22.
Cherry, 1.
Chestnut, 14, 22.
Chrysanthemum, 20 (?).
Cratægus, Sp., 1.
Cucumber, 20.
Cucumis sativus L., 20.
Cucurbita Pepo L., 20.
Dahlia variabilis Desf., 20.
Elm, 10, 14, 22.
Euonymus atropurpurea Jacq., 14.
Fagus Americana Sweet, 14, 22.
Fragaria cult., 4.
Fraxinus Americana L., 22.
Gleditsia tricanthos (L.), 14
Gooseberry, 6.
Grape, 8.
Haw., 1.
Hawthorn, 1.
Helianthus annuus L , 20.
Helianthus sp., 20.
Hickory, 14.
Hicoria (Carya) alba (L.), 14.
Honey Locust, 14.
Honeysuckle, 14.
Hop, 3.
Horse-chestnut, 11.
Humulus Lupulus L., 3.
Ivy, 8.
Juglans cinerea L., 14.
Juglans nigra L., 14.
Kentucky blue grass, 21.
Lancewood, 14.
Lilac, 14.
Linden, 12.

Liriodendron Tulipifera L., 19, 22.
Lonicera Tartarica L., 14.
Malus Malus (L.), 1, 2.
Maple, 9.
Matrimony vine (?).
Morus rubra L., 13.
Mulberry, 13.
New Jersey Tea, 14.
Oak, 16.
Parthenocissus quinquifolia (L.), 8.
Pea, 19.
Peach, 5.
Phlox divaricata L., 20.
Phlox Drummondii Hook, 20.
Phlox paniculata L., 20.
Phlox Sp., 20.
Pisum sativum L., 19.
Plane-tree, 14.
Plantanus occidentalis L., 14.
Poa pratensis L., 21.
Poplar, 7.
Populus tremuloides L., 7.
Prunus Cerasus, 1.
Prunus Persica S. & Z., 5.
Pumpkin, 20.
Pyrus Cydonia L., 1.
Quercus alba L., 16.
Quercus rubra L., 16.
Quince, 1.
Redroot, 14.
Redtop, 21.
Ribes Grossularia L., 6.
Ribes sp., 17.
Rose, 5.
Rosa sp, 5.
Salix cordata Muhl., 7.
Salix sp., 7.
Salsify, 20.
Snowberry, 18.
Spindletree, 14.
Squash, 20.
Strawberry, 4.
Sunflower, 20.
Sycamore, 14.
Symphoricarpos Symphoricarpus (L.), 18.
Syringia vulgaris L., 14.
Tecoma radicans (L.), 14.
Thorn, 1.
Tilia Americana L., 12.
Tragopogon porrifolius L., 20.
Trumpet creeper, 14.
Tulip tree, 19, 22.
Ulmus Americana L., 10, 14, 22.
Vegatable oyster, 20.
Viburnum dentatum L., 14.
Virginia creeper, 8.
Vitis cordifolia Michx., 8.
Vitis sp., 8.
Vitis vinifera L., 8.
Waxwork, 22.
Whitewood, 19, 22.
Willow, 7.
Zinnia elegans Jacq., 20.

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FUNGI AS RELATED TO WEATHER.

The following items concerning crop plants are gathered from the "Weather and Crop Bulletins," issued weekly by the State Weather Service during the months of April to September of the present year.

May 12th—"Pears dropping badly;" "Peaches dropping."

May 19th—"Clover curling badly on high land;" "Keiffer pears dropping;" "Clover wilting on high fields."

May 26th—"Wheat greatly affected by dry weather, and much has turned yellow;" "Clover wilting;" "Fruit dropping;" "Wheat in many places withering;" "Apples dropping badly;" "Wheat turning yellow;" "Tomato plants dying;" "Some wheat rusting."

June 2d—"Clover wilting;" "Clover wilting and dying out."

June 9th—"Rye filling fairly well, some rust;" "Potatoes wilting."

June 16th—"Early cherries ripe, but crop light, continuous rains during the week have caused them to crack and split;" "Much early-planted corn rotted in the ground."

June 23d—"Strawberries rotting on vines;" "Cherries rotting badly;" "Corn turning yellow;" "Wheat ripening fast, but rusting."

June 30th—"Corn turning yellow;" "Wheat badly curled;" "Leaf blight on apple trees and early tomatoes;" "Tomato blight observed in some fields."

July 7th—"Early tomatoes have blighted badly;" "Oats looks badly, much scald and rust noticed;" "Wheat somewhat crinkled."

July 14th—"Fruit dropping badly."

Juyl 21st—"Pears affected with blight;" "Plums rotting badly;" "Cantaloupes blight;" "Peaches poor and dropping;" "Late apples dropping;" "Early peaches and plums rotting badly."

August 4th—"Some fields of potatoes show blight and rot;" "Potatoes show signs of rot in low places;" "Potatoes rotting badly in low fields;" "Asparagus shows a little rust;" "In some fields the potatoes are rotting;" "Grapes in unsprayed vineyards begin to rot;" "Potatoes and summer apples abundant, but rot in former is serious;" "Some twig blight."

August 11th—"Potatoes are showing considerable blight;" "Potatoes rotting;" "Grapes showing some rot;" "Plums rotting badly;" "Some rot among potatoes;" "Potatoes rotting;" "Potatoes are rotting;" "Apples are dropping badly;" "Late tomatoes begin to blight, and the young watermelons are rotting on the vines;" "Much leaf-blight;" "Potato rot prevalent in low places."

August 18th—"Potatoes are rotting badly;" "Potatoes rotting badly;" "Potatoes and grapes rotting badly;" "Cucumber and melon vines blighted;" "Potatoes are rotting to some extent;" "Peaches rotting on the trees;" "Potatoes and corn scalding on low fields;" "Potatoes beginning to rot;" "Potato rot increasing in some places;" "Potatoes rotting badly in low fields;" "Lima beans are molding on the vines;" "Tomatoes are rotting;" "Tomatoes are affected by blight."

August 25th—"Melon, cucumber and pumpkin vines rotting on the ground;" "Potatoes rotting badly;" "Plums rotting somewhat;" "Potatoes injured by blight;" "Potatoes rotting badly;" "Potatoes rotting badly;" "Some rot in potatoes;" "In some patches potato vines are turning black;" "Potatoes, but little rot being noticed;" "Potatoes, average yield, but rotting on low ground;" "Lima beans molding;" "Potatoes rotted considerably;" "Lima beans rotting and millet rusting;" "Potatoes still rotting;" "Potatoes rotting considerably;" "Potatoes rotting badly;" "Tomatoes are rotting;" "Grapes are rotting badly;" "Lima beans ruined by the white mold;" "Lima beans molding;" "Early potatoes a fine crop, no rot;" "Citron vines have a stunted appearance, rusty blight has begun its fatal attack in places;" "Potato rot severe in low fields;" "Peaches begin to rot and apples to drop badly;" "Melon and citron vines blighted."

September 1st—"Potatoes rotting badly;" "Whole fields of potatoes rotted;" "Much blight in potatoes;" "Potatoes fair where not blighted;" "Potatoes rotting;" "Potatoes have ceased rotting;" "Potatoes badly infested with rot;" "Keiffer pear trees leafless;" "Potatoes good, no serious rot noticed;" "Potatoes rotting badly;" "Potatoes rotting badly;" "Potatoes rotting badly;" "Grapes rotting;" "Lima beans molding;" "Potato rot reported in places;" "Blight and rot of various kinds quite prevalent;" "Potato rot increasing;" "Lower leaves of tomatoes have blighted;" "Tomatoes rot badly;" "Citron and melon vines nearly all dead and crop a failure;" "Tomatoes rotting."

September 9th—"Rot still continues serious in potatoes;" "Potatoes and tomatoes rotting badly;" "Tomatoes and potatoes continue rotting badly;" "Potatoes have ceased rotting;" "Lima beans badly mildewed" "Late potatoes rotting badly;" "Potatoes improving, only a little rot noticed;" "Grapes ripening rapidly, but rotting some;" "Late peaches rotting and cracking;" "Potatoes continue rotting;" "Grapes rotting;" "Potatoes blighting and rotting;" "Corn and tomatoes, some rot noticed;" "Potatoes still rotting;" "Lima beans utterly ruined by white mold;" "Potatoes rotting;" "Tomatoes rotting and blighting badly;" "Malignant potato rot interferes in many cases with reliable storage or shipment."

September 15th—"Potatoes rotting badly;" "Potatoes rotting badly;" "Potatoes a failure;" "Lima beans and late tomatoes a total failure;" "Tomatoes rotting badly;" "Potatoes in some fields rotted badly;" "Tomatoes rotting badly;" "Peaches rotting badly;" "Potato rot serious;" "Corn affected with blight;" "White potato rot decreasing;" "Tomatoes rotting badly;" "Tomatoes blighting and rotting on the vines;" "All melon and pickle vines destroyed;" "Tomatoes blighting badly;" "Watermelons a failure;" "Only a little asparagus rust observed;" "Winter apples dropping badly;" "Peaches a failure;" "All vine crops still rotting badly;" "Watermelons and cantaloupes complete failure;" "Late pickles scalding;" "Second crop of potatoes, in most cases, will be a failure."

The crops mentioned in the above reports are here arranged alphabetically, thus showing the number of times a specific trouble is mentioned. The numeral in parentheses indicates the times the same disease is reported for the given date:

Apples.—May 26th, dropping. June 30th, leaf blight. July 21st, dropping. August 11th, dropping. August 25th, drop. September 15th, dropping.

Asparagus.—August 4th, rust. September 15th, rust.

Corn.—June 16th, rotted. June 23d, turning yellow. June 30th, turning yellow. August 18th, scalding. September 9th, rot. September 15th, blight.

Cantaloupes.—July 21st, blight.

Clover.—May 19th, curling; wilting (2). June 2d, wilting (2); dying out.

Cucumber.—August 18th, blighted. August 25th, rotting.

Citron.—August 25th, vines have a stunted appearance; blighted. September 1st, dead.

Cherries.—June 16th, crack and split. June 23d, rotting.

Grapes.—August 4th, rot. August 11th, rot. August 18th, rotting. August 25th, rotting. September 1st, rotting. September 9th, rotting (2).

Lima Beans.—August 18th, moulding. August 25th, moulding (2); rotting; white mold. September 1st, molding. September 9th, mildewed.

Millet.—August 25th, rusting.

Melon.—August 18th, blighted. August 25th, rotting; blighted. September 1st, dead.

Oats.—July 7th, scald and rust.

Plums.—July 21st, rotting (2). August 11th, rotting. August 25th, rotting.

Potatoes.—June 9th, wilting. August 4th, blight; rot (3); rotting (2). August 11th, blight; rotting (3); rot (2). August 18th, rotting (5); scalding; rot (2). August 25th, rotting (7); blight; rot (2); vines turning black; rotted. September 1st, rotting (5); rotted; blight; blighted; rot (3). September 9th, rot (2); rotting (7); blighting. September 15th, rotting (2); rotted; rot.

Pickles.—September 15th, scalding.

Peaches.—May 12th, dropping. July 21st, dropping; rotting. August 18th, rotting. August 25th, rot. September 9th, rotting and cracking. September 15th, rotting.

Pears.—May 12th, dropping. May 19th, Keiffer pears dropping. July 21st, blight. September 1st, Keiffer trees leafless.

Pumpkin.—August 25th, rotting.

Rye.—June 9th, some rust.

Strawberries.—June 23d, rotting.

Tomatoes.—May 26th, dying. June 30th, leaf blight; blight. July 7th, blighted. August 11th, blight. August 18th, rotting; blight. August 25th, rotting. September 1st, blighted; rot; rotting (2). September 9th, rot; rotting; blighting. September 15th, rotting (4); blighting (2).

Watermelons.—August 11th, rotting.

Wheat.—May 26th, turned yellow (2); withering; rusting. June 23d, rusting. June 30th, curled. July 7th, crinkled.

Mildew of Lima Beans.

A glance at the above reports of the crop correspondents shows that the mildew of the lima beans is common. This disease was considered at some length in the Report for last year (pages 399–403), where three engravings were given showing appearance and microscopic structure of the mildew. As the trouble is apparently upon the increase, the growers of lima beans may find the information in the Report for 1902 of some service. The Experiment Station also has a Bulletin (No. 151—"Bean Diseases and Their Remedies") that may be of service in fortifying against this enemy.

The writer was recently particularly impressed with the fact that the mildew was unusually abundant upon vines that were directly over a pile of shelled pods, many of them mildewed, that had been thrown there, instead of in an out of the way garbage barrel. The fungus is exceedingly contagious, and every effort should be made to remove the mildewed pods from the field, instead of taking them back again after they have been shelled.

Growers of lima beans may well make note of the susceptibility of varieties, with the hope of finding some sorts that are less subject to the disease than others. A study of the varieties of asparagus, with regard to the rust, has been one of great profit, and the same kind of watchfulness may be exercised with all kinds of crops.

In closing it is remarked that the fungus in question of the lima beans is a mildew closely related with several others, as the ones upon lettuce, grape, onion, spinach, etc. It is well, therefore, to reserve the terms "blight," "rot," and even "mold," for other forms of fungi. Whenever any of the three last names are mentioned in connection with the lima beans, the trouble is more than likely the work of one and the same mildew.

The Rotting of Potatoes.

The rotting of potatoes was reported in the Weather and Crop Bulletins as early as August 4th, and for weeks the number of reports of potato rot increased. On August 18th the correspondents reported as follows: "Potatoes are rotting badly;" "Potatoes rotting in many fields;" "Potato rot increasing in some places." For August 25th and September 1st the common expression was "Potatoes are rotting badly."

The common field potato is troubled with a number of plant diseases, all of which may have had some part in the wholesale decay above indicated. An examination of the fields, however, leads to the opinion that the chief trouble has been the so-called potato rot. In 1889 there was a similar outbreak of this disease, and a leaflet (Special Bulletin *G*) was prepared and circulated among the potato growers. From it some of the facts connected with the potato rot are gathered.

This disease is caused by a fungus (*Phytophthora infestans* D By.) which is closely related to the downy mildew upon the grape. It first attacks the potato leaves, causing them to curl and become "frosty" upon the under side, after which they quickly turn brown and decay. From the leaves the fine threads of the fungus pass to the stems, and, if the conditions are favorable, the vines are soon dead and leafless. The potatoes are the last to be attacked, and, owing to their size and solidity, may be considerably infested internally with the fine filaments of the fungus before the condition familiarly known as the rot becomes evident. From this it follows that the loss from the decay of the tubers after harvesting the crop may possibly be more than that occurring in the field.

Conditions Favoring the Rot.—The first essential is abundant moisture. Since 1840, when it is thought that the trouble was introduced into this country from South America, the wet years have been the seasons of most rot. A moist atmosphere favors the development of the fungus in the leaves and stems; the rains assist in conveying the germs (spores) from the foliage to the tubers, and the wet soil encourages the growth of the filaments that may have reached the potatoes by descending through the stems. A second favoring condition is warm weather—not hot or cold, but a condition of the atmosphere which obtains when there is a week or month of showery, summer weather, often spoken of as "close" or "muggy"—just such weather, in fact, as we have experienced throughout the State during August. A large quantity of decaying organic matter, as coarse barnyard manure, perhaps, stimulates the development of the rot, especially if accompanied by favorable conditions of temperature and miosture.

Treatment of Infested Fields.—It is evident that, after the vines have been killed, there can be no further growth of the tubers, and as the disease first attacks the leaves and tips of the vines and works downward towards, and finally into, the tubers, it follows that there can be no loss in yield, and a great possible gain in healthfulness, by early digging. As a rule, the potatoes should be removed from the soil as soon as possible after the vines have been "struck" by the rot. The dead vines abound in the spores of the disease, and it is possible for the tubers to be infested by contact with the vines at the time of digging. Therefore, it is an important and inexpensive precaution to rake the vines into heaps and burn them before the potatoes are dug, at the same time destroying millions of germs of the rot, some of which might otherwise do injury elsewhere.

Treatment of Harvested Tubers.—The same conditions favor the rot after as before digging, and, therefore, the dug tubers should be left to dry thoroughly, then the sound ones can be stored where they can be kept dry, cool and with a good circulation of fresh air. A damp, warm, close cellar favors the growth of the rot. Air-slaked lime, a handful or so per bushel, may be dusted over the freshly-harvested potatoes to destroy any adhering germs.

Preventive Measures.—The conditions which favor the rot are not under human control, but knowing the habits of the pest and that it does not usually make its appearance until midsummer, it follows that early varieties of potatoes, when planted early, will usually mature before the rot appears, and thus escape. It is also to be borne in mind that a loose, light soil does not promote the decay like a clayey one, in which the water is held and air enters with difficulty. From the nature of the disease it is not expected that anyone would think of attempting a second crop upon an infected field until some years have elapsed. Probably much of the trouble arises from the seed not being free from the disease. If possible, the potatoes for planting should be obtained from a locality where rot has not prevailed. The tubers for seed may be soaked in a solution of bluestone (sulphate of copper) before planting. Some recommend placing the "seed" in an oven for a few moments, heated to near a hundred degrees. If possible, plant upon a naturally dry or well-drained soil, and hill up the earth well around the vines at the last plowing, thus giving a good covering to the potatoes and making it less easy for the germs to reach the tubers through the soil.

Historical.

Concerning the history of the disease above considered, Dr. Farlow* has written: "At times its advent is so sudden that within a few hours the potato fields change from green to brown and black, and the plants which in the morning gave promise of an abundant crop, before night might present a mass of decaying vegetation, in which are involved not only the leaves and stems, but also the tubers. The disease occurred in this violent form in 1842 and again in 1845, and spread over a good part of the United State and the British Provinces, and also destroyed the crop in Great Britain, Ireland, Belgium and parts of Germany and France. The greatest injury was done in Nova Scotia, New Brunswick and Ireland, owing to the fact that in these countries the potato was the principal crop. Since 1845 the disease has recurred, but never with such violence, although during the year 1874 the damage was considerable. Although public attention was first called to the rot in 1842, it is not likely that it then appeared for the first time, but we must suppose that some of the vaguely-described epidemics of the last century were of the same nature.

"It is with sudden and violent outbreaks, as those of 1842 and 1845, that in the public mind the potato rot is associated. As a rule, however, the disease is of a milder type."

Since 1889 there has been, in New Jersey, one very wet July, namely, in 1897, when the rainfall reached the total average for the

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*The Potato Rot—Bulletin of the Bussey Institution, Harvard University, 1875.

State of 11.42 inches. This is the heaviest precipitation for a single month during the fifteen years that the writer has been connected with the Experiment Station. While there were excessive rains in 1897, there were also periods of drought during the growing season. Thus a dry spell was broken by the heavy storms of July, and these, in turn, were followed by a dry September, with less than half of the average rainfall. The conditions for an outbreak of the potato rot fungi were not as favorable in 1897 as in 1889, when September had double its average rainfall. However, the reports of the crop correspondents show that there was considerable loss in the potato fields. It is probably true that a wet July is very favorable to the development of the potato rot, and when this is followed by large rainfalls in August and September the crop is quite certain to suffer.

In this report a table of the monthly rainfall since 1888 is published, together with the averages for each month and each year during the fifteen years.

The accompanying plate (No. XIV.) is from Professor Galloway's Report of Section of Vegetable Pathology, United States Department of Agriculture, for 1888, and the explanations below are from the same source:

Fig. 1. Section through a diseased leaf, showing the mycelium in the tissues and two external spore-bearing hyphæ projecting through a stoma.

Fig. 2. Conidia and conidiophores more enlarged The epidermis and stoma are shown in the surface view. (F. L. Schribner, del.)

Fig. 3. A series of drawings, representing successive stages in the development of a conidium: *a*, end of conidiophore slightly swollen; *b*, *c*, successive stages in growth of the conidium; *d*, the conidiophore has pushed on, leaving the conidium already formed, attached to an enlargement below the point, and has begun to form another conidium on the end; *e*, the first-formed conidium has fallen from the enlargement of the conidiophore at *g*, and the second conidium formed is in turn left behind by the growing conidiophore, which is, forming a third conidium at the end.

Fig. 4. Mycelium in the tissue of a potato tuber. (F. L. S., del.)

Fig. 5. Series of figures representing the germination of a conidium: *a*, mature conidium; *b*, same, after remaining some time in water, five vacuoles have made their appearance; *c*, the contents are segmented into five distinct parts, each of which is provided with a vacuole; *d*, the exospore has ruptured and the zoospores are in the act of escaping; *e*, free zoospore; *f*, same a little later the vacuoles have become smaller; *g*, same, still later, the cilia are gone and the zoospore has come to rest; *h*, beginning of germination; *i*, *k*, *l*, successive stages in the growth of the germ tube or first mycelium filament; *m*, entrance of germ tube into the leaf through a stoma.

Fig. 6. Section of leaf, showing the penetration of a germ tube into the epidermis through the cell wall.

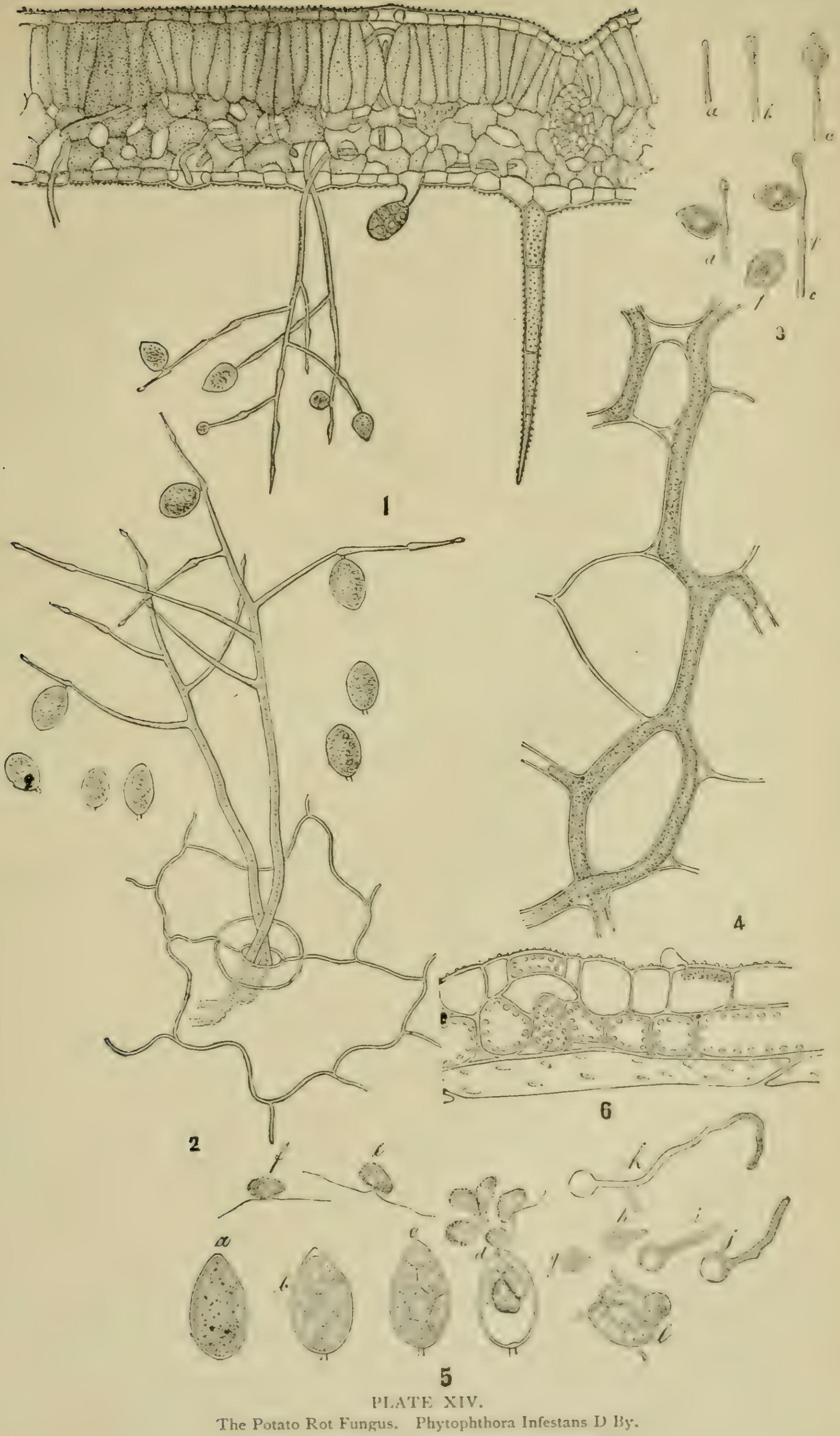
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PLATE XIV.
The Potato Rot Fungus. Phytophthora Infestans D By.
[From Report U. S. Department of Agriculture.]

Diseases of Tomatoes.

From the above reports of crop correspondents concerning the condition of the tomato industry in the State during the past season it is evident that there has been much trouble with one of its leading truck crops. In fact, for some years past the growing of tomatoes has been attended with much anxiety, due to several causes, but chief among them are the various fungous enemies.

The subject of tomato growing, particularly that of its diseases, has been considered by this department, as a reference to the past reports will show, and it may be well to make a summary of the points that have been gained.

Tomoto Bacteriosis.—One of the most difficult diseases of the tomato for the trucker to contend with is the Bacteriosis, due to a microbe (*Bacillus Solanacearum* Sm.), which is often first recognized by a sudden wilting of the foliage, that soon changes to a yellowish-green and then to brown. Dr. E. F. Smith* has made a special study of this disease, and succeeded in inoculating the Jamestown weed, black nightshade, ground cherry and petunias, all of which belong to the tomato family of plants, with this wilt disease.

The disease is spread by means of the microscopic germs, and anything that opens up a passageway from the atmosphere to the tissue within will tend to develop the disease. Dr. Smith has been able to transmit the microbes from one plant to another by means of Colorado potato beetles, and determined the time of incubation to be from seven to nine days. Other insects, most likely, are active agents in the spread of this disease.

Concerning preventive measures, it is evident that the injuries from insects should be reduced to a minimum by using mixtures that will destroy these pests, and thereby preserve the skin of the tomato plant intact, thus destroying the carrier of the germs and keeping the natural barrier unbroken. When plants go down with this disease they should be burned, so that they may not remain as sources of the infection. As a further precaution, tomato growing should not be attempted continually upon any soil, and emphatically so when this disease is in evidence. Lastly, procure plants that are not likely to have been exposed to the Bacteriosis before being set in the field.

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*A Bacterial Disease of Tomato, Eggplant and Irish Potato. Bulletin 12, Division of Vegetable Pathology and Physiology, U. S. Department of Agriculture 1896.

Tomato Leaf Spot.

Perhaps the most destructive fungous that preys upon the tomato is the leaf spot (*Septoria Lycopersici* Speg.), which is distinguished, first, by the small, oval spots it produces upon leaf and stem, followed by a dying of the foliage. A field of tomatoes badly affected with the Septoria will result in bare stems and small, stunted fruits. The leaf-spot fungus often attacks the plants before leaving the propagating beds and goes with the seedlings to their places in the field.

As precautionary measures it is well to use fresh soil for the seed beds—that is, earth that has not been exposed to the germs—and not set plants in ground where the disease prevailed the year before. When a field is badly affected all the dead and dying plants should be pulled up and burned, thus destroying millions of the active spores. The matter of spraying will be considered near the close of the paper.

Tomato Fruit Rot.

There are two leading fruit diseases of the tomato, namely, the Black Mold, caused by the fungus *Macrosporium Tomato* Ck. and the Tomato Anthracnose due to *Colletotrichum phomoides* Sacc.

Black Mold.—This trouble usually begins at the blossom end of the fruit, this being the weak point in fruits generally. In the case of the tomato this end is often brought against the earth, and this facilitates the entrance of the germs of decay into this imperfectly protected portion of the tomato. The remains of the flower may also remain and add to the ease with which a rot may gain a foothold. It is a fact that those varieties of tomatoes which are smooth-skinned and have no well-filled out and perfect blossom end are less likely to suffer from the Black Mold. It therefore follows that as a wise precaution any rough-skinned varieties with decidedly imperfect blossom ends should be discarded so far as avoiding the fruit rot is concerned. As a rule the smooth fruits are the ones that are preferred for the market and the table. The habit of the plant may have much to do with the amount of this fruit decay. Thus the "Trophy," with us, rots twice as badly as the "Dwarf Champion," and this is probably due to the more upright growth of the plants of the latter variety, thus tending to keep the fruits above the soil. The texture of the fruit may have a decided influence, for it has been observed that the "Peach," a soft, flabby fruit, with rough skin, is much subject to decay. It is evident that something may be done to diminish the fruit rot in tomatoes by breeding and selecting for upright plants with smooth fruits, and it is hoped that some actual results may be recorded in coming reports.

Anthracnose.—This disease is most frequently met with upon maturing fruit, causing them to become sunken in minute saucer-shaped places that deepen and broaden until the whole fruit becomes a misshapen mass of decay. This disease is usually not as common as the black mold.

Experiments in Spraying Tomatoes.

Tests of fungicides for diseases of tomatoes were begun by this department in 1894, when a fifth of an acre of "Trophy" tomatoes was under treatment. It being the first season for this crop upon this portion of land, and possibly for climatic reasons also, there was very little of any of the various diseases that affected tomatoes. In 1895 the same land was continued in tomatoes and the diseases were still not at all prevalent. It is, however, recorded that the Bordeaux mixture reduced the decay of fruit to one-half that upon the untreated ground.

A third crop of tomatoes was grown upon the same soil in 1896, and there was a material increase of the leaf-blight, but the loss due to fruit rot was unimportant. Bordeaux and other fungicides, as soda bordeaux and potash bordeaux were effective in checking the diseases. It was also shown that land upon which old tomato plants had remained during the previous winter gave an increased amount of blight.

In 1897 tomatoes were again grown upon Plot II., Series III., for the fourth successive season; the record shows that during this year there was very little fruit rot, and the only leaf disease at all serious was the leaf-spot (*Septoria Lycopersici* Speg.), and this was kept under control by the frequent use of Bordeaux mixture and other fungicides.

During 1898 a half of Plot II., Series III., was kept in tomatoes for the fifth successive season, and it was shown that the total crop upon this land exceeded that of a corresponding number of the same varieties of plants upon an equal area that was new to tomatoes. The total weight of ripe marketable fruits upon the old land was 971.75

pounds and 740.50 upon the new land. This indicates that with the care taken to spray the vines, gather and destroy all decaying fruits and remove and burn the vines in the autumn, tomatoes have been grown upon the same land for five successive years without apparent disadvantage to the crop. The sprayings were upon June 1st, 24th, July 6th, 15th, 30th, August 8th, 25th, September 6th and 23d, nine applications in all.

The western half of Plot II., Series III., was set to tomatoes for the sixth successive time in 1899. A duplicate set of the above plants was grown upon land new to tomatoes and the yield of marketable fruits was somewhat greater upon the new than the old land, the total in pounds for the former being 1,429, and for the latter, 1,057 pounds. The results of the eleven sprayings were not striking, as the fruit rot and leaf diseases were but little in evidence. However, toward the close of the season the untreated plants were defoliated by a leaf mold (*Cladosporium fulvum* Cke.)

In 1900 the seventh successive crop was grown upon old tomato land and a duplicate set upon land new to the crop, with the result that there was a larger crop upon the new land, as the following figures for marketable fruits show: The total number of fruits upon the new land was 4,856, with a weight of 1,005 pounds, while the old land yielded 3,995 fruits, weighing 885 pounds, or a gain of 861 fruits and 120 pounds, respectively, in favor of the new land. This experiment of growing tomatoes for some years upon the same land indicates that with the precautions previously named, tomatoes may thrive upon the same land for a long time. There is, however, a falling off in the sixth and seventh seasons, as compared with duplicate sets of plants grown upon land where tomatoes possibly have never been set before. This success does not demonstrate that it is best, to keep land in tomatoes for general trucking, a rotation of crops should be maintained, but emphasizes the fact that comparative freedom from diseases may follow when care is exercised to keep the plants free from rotten fruit by removal of all decayed specimens and the thorough spraying of the vines with the Bordeaux mixture, beginning in May and continuing every two weeks through the growing season. The value of these sanitary measures has been so well demonstrated that while tomato growing has continued at the Experiment Area, it has been for the purpose of breeding with the hope of increasing the vigor and uprightness of the vine and reduce the seed and improve the quality of the fruits. Upon these points something is said, under the proper heading, elsewhere in this report.

Troubles of Tomatoes Under Glass.

Leaf Mold.—The chief fungous disease of greenhouse tomatoes is the leaf mold, due to the fungus *Cladosporium fulvum* Cke. This is quickly recognized by the pale, olive-colored, irregular patches upon the under side of the foliage, due to a felt of fungous threads and spores. Soon the infested areas become brown, and they are no longer of use to the plant. By means of the multitudes of active spores the mold quickly spreads, and the plants may be ruined. The fruits may be attacked by the same fungus, and undergo a rapid, noisome, watery decay.

In addition to the spraying recommended elsewhere (page 547) for outdoor tomatoes, it is necessary to have a good circulation of air. Many successful growers are impressed with the importance of training the plants high above the soil, even pruning away any branches that form near the benches.

Dropsy or Œdema.—Many greenhouse plants suffer from a disease which is not associated with any fungus, and appears to be entirely physiological. For example, the common geranium (Pelargonium) is frequently thus attacked, and the writer treated of this malady, with an engraving, in a previous report,* and within the past week the same trouble has been met with.

The first appearance of the trouble is the translucent dots, that may be best seen by holding the tomato leaf up against the light. This subject, in connection with the tomato, has been studied by Professor Atkinson,† and he concludes that the trouble is due to excess of water, favored by insufficient light—that is, a wet soil and a soil-temperature near that of the air. In short, the long nights, short days and cloudy weather of late winter induce the dropsical trouble, especially with a wet, warm soil, thus making root action excessive. The remedy, therefore, is to be found, as far as possible, in providing a cooler, dryer soil for the roots, with increased light for the stems and leaves.

In the winter of 1901–02 there was much of the Œdema in a lot of young tomato plants, in pots, that were standing upon a side shelf of the greenhouse and directly over a set of heating-pipes. The soil in the pots, by this means, was quite warm and kept wet by frequent watering. After the dropsy was manifest a majority of the pots were transferred to a middle bench, with no heating-pipes beneath, and the tomato plants here outgrew the trouble. Those left upon the side bench grew worse, and finally perished.

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* Report of Botanical Department New Jersey Experiment Station for 1893, pages 432–433.

† Œdema of the Tomato, Bulletin 53, New York (Cornell) Experiment Station, May, 1893.

Diseases in the Pear Orchard.

The troubles in the pear orchard have been greater during the season than the reports of the crop correspondents would suggest. There are three leading fungous enemies of the pear, while there are several that play a secondary role in the shortening of the crop. The most conspicuous is the Fire Blight, which is an old and widespread disease, easily recognized by the brown, dead leaves clinging to dying branches in midsummer, giving the appearance of having been scorched by fire. Occasionally only one twig or large branch may be thus destroyed, but in its worst form the whole tree is stricken with the disease. The trouble is due to an invasion of microbes (*Bacillus amylovorus* Burl.), which multiply with great rapidity in the growing parts of the tree. These germs winter over in the twigs and ooze out through rifts in the bark in spring, and, the substance being attractive to insects, are carried by them to the opening buds and blossom when inoculation takes place, and the blight spreads down the growing twigs, causing the scorched appearance before mentioned.

Owing to the nature of the disease it is not easy to check with the ordinary spraying mixtures. Some varieties are less subject to fire blight than others, and this fact should be kept in mind in selecting trees for setting an orchard. When twigs are killed they are only sources of further infection, and should be removed and burned.

A second fungous enemy is the Leaf Blight (*Entomosporium maculatum* Sw.), and is one of the most common of the troubles of the pear orchard. It is this that has been actively at work this season in bringing about the loss of foliage to a large number of the pear trees of the State. As the common name indicates, this fungus produces a blight in the foliage, recognized at first by ashy spots in the leaves, followed by a premature falling to the ground, leaving the branches bare and the fruit to shrivel. This fungus has been controlled in many instances by spraying the trees with the Bordeaux mixture. The writer has followed the trials in spraying where the leaves were saved to the trees and the heavy crop of fruit matured handsomely by treating the orchard to cupram, which is a mixture consisting of—carbonate of copper, five ounces; strong ammonia, three quarts, and water, fifty gallons. This mixture has the advantage over the Bordeaux in being without lime and not coating the fruit seriously. Some pear growers use the Bordeaux for the first three sprayings, one before blossoming and two at intervals of about two weeks, afterwards, followed by the cupram as the fruit reaches larger size.

The third pear enemy is the Scab (*Fusicladium pirinum* Fcl.), which is easily mistaken for the leaf blight, just considered, but a close examination shows the spots upon the leaves to be more superficial. The fungus, by means of a network of fine, dark-brown threads, becomes fastened to the leaf and produces a patch, suggesting the common name of scab. It grows, also, upon the twigs, and frequently seriously defaces the fruit. When it attacks the young pear, just as the flower falls, a misshapen and worthless fruit is often the result. This fungus is very closely related to the one causing the scab upon apples, and should receive the same treatment, namely, at least three sprayings with Bordeaux mixture at intervals of about two weeks, beginning at the time the buds are opening, but not while the flowers are in bloom.

Aside from the fire blight, leaf blight and scab, above considered, there are other fungi that prey upon the pear, but these are the chief enemies to this crop. During this season there have been specimens of twigs and foliage sent to the Station that were almost black with a growth of various "soot fungi." These usually follow the injuries of insects, and the black coating often develops from the exudation produced by ants and other of the tribe. It is seen that, when a pear orchard suffers from a falling of its foliage, the trouble may be due to one or more of many causes. Any increase in the rainfall will usually be followed by a greater development of these enemies. As a general rule, in sections where pears are liable to suffer, it is well to anticipate the troubles by spraying the orchard early in the spring, as above indicated, and continue the applications throughout the season should the weather be favorable for the development of the diseases.

Temperature for Past Fifteen Years.

	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	Av'ge.
January	36.2	41.3	34.2	29.8	21.6	34.2	28.1	28.6	29.0	32.6	30.1	32.4	30.4	23.4	30.4	31.1
February	27.7	39.9	38.0	33.6	30.1	29.7	23.6	32.1	32.5	32.7	25.8	31.0	25.4	27.4	33.7	30.8
March	40.5	37.6	37.2	34.4	37.0	44.2	36.7	34.0	40.0	45.1	38.6	35.6	39.2	43.9	47.6	39.4
April	51.2	50.4	52.0	49.3	49.2	50.3	49.1	52.4	50.4	47.8	49.9	50.8	48.3	50.2	50.9	50.1
May	62.3	60.7	59.5	60.1	59.4	61.4	60.9	65.3	60.6	58.5	61.1	60.9	58.6	60.3	62.7	60.8
June	69.9	70.7	69.7	72.4	69.7	70.6	71.7	68.1	66.1	70.1	72.3	70.4	70.0	67.5	64.0	69.5
July	73.4	72.5	70.1	74.3	73.9	75.7	70.9	75.0	74.1	75.3	74.7	75.9	77.3	73.0	73.3	73.9
August	69.6	71.5	72.8	73.4	72.8	70.9	74.2	73.6	71.0	74.8	72.3	76.3	73.8	70.1	68.4	72.3
September	64.8	64.4	68.7	64.2	62.7	68.3	69.7	65.1	65.5	68.6	64.4	69.9	66.8	64.6	65.0	66.1
October	50.8	53.9	52.8	53.6	55.2	55.3	49.9	51.5	55.8	56.5	56.6	59.9	54.4	56.0	55.9	54.5
November	45.7	43.8	42.2	41.9	41.9	40.3	45.7	48.2	43.8	42.4	44.0	47.5	38.5	49.3	39.9	43.7
December	41.5	30.9	40.9	30.4	31.9	34.8	37.2	31.3	35.1	33.3	35.5	34.4	32.6	31.7	28.6	34.1
Average	52.8	53.1	53.2	51.7	50.7	52.9	51.5	52.1	51.9	53.1	52.1	53.7	51.3	51.9	51.7	52.2

Rainfall for Past Fifteen Years.

	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	Av'ge.
January	5.68	2.29	6.57	5.15	3.04	2.34	4.66	1.66	2.80	4.20	4.01	3.85	2.52	3.28	3.90	3.73
February	2.49	4.17	5.11	1.63	5.73	4.42	1.28	6.77	3.61	3.48	6.06	5.30	0.94	6.24	4.87	4.14
March	3.79	6.08	5.06	4.75	3.73	1.77	3.16	5.34	2.87	3.33	6.54	3.51	4.64	4.34	5.13	4.26
April	5.32	2.65	2.19	2.49	5.21	3.09	4.88	1.35	3.79	3.74	1.73	2.29	6.31	3.62	3.97	3.50
May	4.09	4.24	2.97	5.04	4.07	7.72	2.85	3.21	5.68	7.00	1.92	4.71	5.60	2.04	0.59	4.11
June	3.73	3.59	2.92	3.85	2.95	2.28	3.24	5.46	3.38	2.10	2.50	3.08	1.57	6.57	7.68	3.66
July	10.19	5.62	5.30	4.03	2.72	1.66	4.26	5.50	11.42	4.96	5.75	4.74	5.87	4.78	5.51	5.49
August	5.18	4.90	5.32	3.63	6.52	2.58	2.53	1.83	4.39	5.36	4.36	2.68	9.43	3.91	6.95	4.63
September	8.36	4.75	2.46	1.81	3.30	7.46	1.07	4.37	1.65	2.00	5.88	2.86	3.38	5.65	3.34	3.88
October	3.80	6.33	3.44	0.52	4.22	5.67	3.66	2.24	2.43	5.76	2.72	3.70	1.93	6.39	8.92	4.11
November	8.48	0.82	2.39	7.29	3.48	3.34	3.17	3.05	4.59	6.76	2.29	3.43	2.38	2.20	1.26	3.66
December	1.62	3.89	4.25	1.87	3.39	4.36	2.61	1.43	4.90	3.53	2.11	2.59	7.30	7.23	4.08	3.68
Totals	62.73	49.33	47.98	42.06	48.26	44.69	37.37	42.21	51.42	52.22	45.87	42.74	51.87	56.25	56.20	48.73

Sunshine for the Past Fifteen Years in Percentage of Clear-Fair Days.

	1889. Per cent.	1890. Per cent.	1891. Per cent.	1892. Per cent.	1893. Per cent.	1894. Per cent.	1895. Per cent.	1896. Per cent.	1897. Per cent.	1898. Per cent.	1899. Per cent.	1900. Per cent.	1901. Per cent.	1902. Per cent.	1903. Per cent.	Av'ge. Per cent.
January	71	65	70	61	74	58	68	71	61	65	68	71	71	68	65	67.1
February	68	57	45	55	54	65	79	62	64	68	58	64	86	64	71	64.0
March	58	59	59	71	65	74	65	68	65	61	55	77	61	71	61	64.7
April	53	76	80	73	60	70	60	76	83	62	87	77	50	70	66	69.7
May	65	66	64	71	69	65	78	71	78	52	77	75	58	84	84	69.8
June	66	80	76	76	70	83	73	73	80	87	84	80	87	83	53	76.7
July	58	76	69	84	87	84	78	74	68	74	77	87	71	71	84	76.2
August	74	77	61	78	81	80	90	87	84	77	71	84	71	90	65	78.0
September	53	66	83	87	73	66	90	70	87	83	80	80	80	60	83	76.1
October	61	55	71	84	71	61	83	61	71	69	74	58	81	71	71	69.4
November	57	80	73	60	71	66	65	61	63	63	77	63	70	70	80	67.9
December	71	65	71	65	70	68	65	79	61	71	77	77	68	65	74	69.8
Average	62.9	68.5	68.5	72.1	70.4	70.0	74.5	71.1	72.1	69.4	73.7	73.6	71.2	72.3	71.5	70,8

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Report of the Botanist.

Report of the Botanist.

BYRON D. HALSTED, Sc.D.
Earle J. Owen, B.S., and J. K. Shaw, B.S., Assistants.

Plant breeding has been a leading feature of the work in the Botanical Department, for the year ending November 30, 1904, and along lines mentioned in the annual reports for some time past.

During the year the "Voorhees Red" sweet corn has been sent out to four hundred persons and from these many satisfactory replies have been received. A year of substantial progress has been made in the cross between the "Black Mexican" and "Country Gentleman" sweet corn and two new varieties from these reciprocal crosses are in sight. A very full list of sweet corns have been grown the present season and many crosses secured, some of which among the superior sorts it is hoped will be a material gain. A very early sweet corn may be had without resort to the two frequent method, now in vogue, of growing a dwarf dent or flint sort for the early crop.

A full list of beans has been grown, including the wax and green-podded bush beans, and the pole, and dwarf limas. The crosses among the last named varieties have given at least two sorts that after five years of selection are ready for distribution. Many crosses have been secured this season among the wax varieties and also among the green-podded sorts with indications that some success has attained the attempts to breed the wax and green-podded varieties together and these and the lima beans.

A considerable portion of the Experiment Grounds has been devoted to the work with tomatoes. Nearly all the commercial varieties have been grown for the purpose of selecting the best sorts for further work in breeding. Many crosses over a wide range of varieties have been secured. Opportunity was offered for a study of the earliness and other characteristics of many varieties as also a comparison of their yield under the uniform conditions that obtained upon the trial grounds. The "Station

Yellow" tomato has been grown another year and its type is so well fixed that now seed of this yellow upright or "dwarf" variety is ready for distribution.

Crosses among the eggplants have been grown for another year and with several new commercial varieties further breeding has been carried on.

Last year crosses were obtained between certain bush squashes. These have been grown the present season and some progress has doubtless been made in fixing the characters of these crosses. Many other combinations have been made this year. Among others, there is a possible hope of one between the bush and the winter sorts.

The work with the fringed Drummond phlox has been confined to the selection of a white variety of great beauty which in time it is hoped will become fixed.

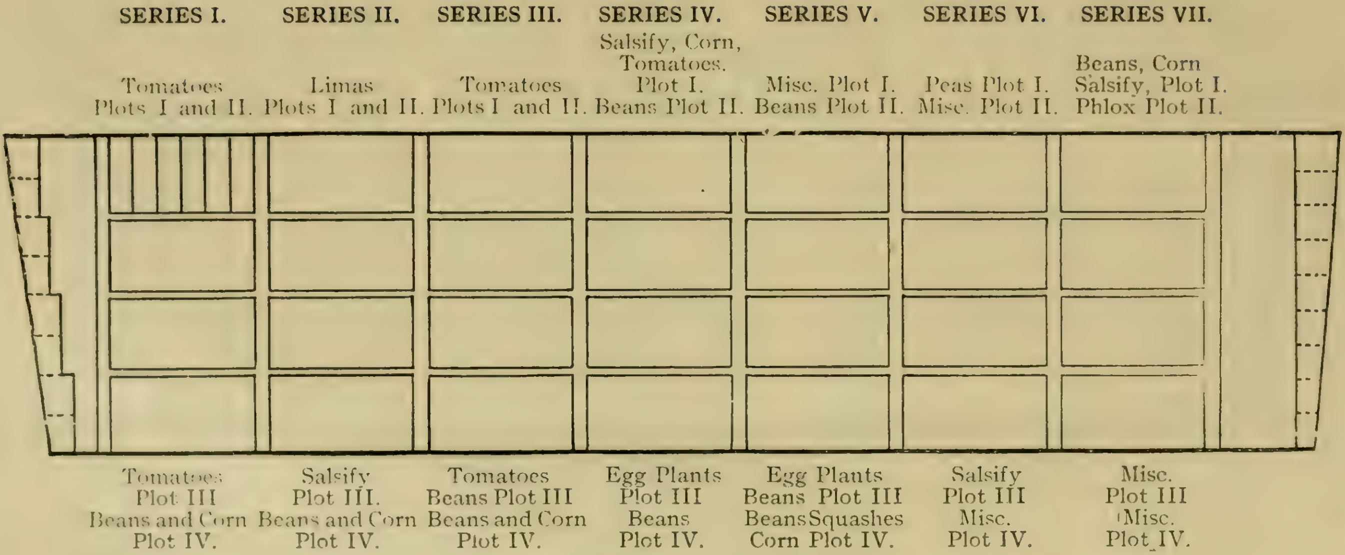
Bulletin No. 170, "Experiments in Crossing Sweet Corn", of twenty-four pages and four page-plates, was published February 5, 1904.

Mr. J. A. Kelsey, after several years of faithful service, and owing to severe illness, was obliged to resign his position as assistant on April 1st of the present year. Mr. E. J. Owen, a graduate of Rutgers College was appointed assistant in horticulture in March, and shortly after Mr. J. K. Shaw, of the University of Vermont, was added as assistant in breeding. Sickness on the part of the writer has continued and prevented him from giving the full amount of attention to the Department.

The Experiment Area.

Upon the next page is given the plan of the Experiment Area which consists of two acres divided into seven series with four plots to each series. Paths four feet wide separate the series, while each series is again divided by two-foot paths running lengthwise of the Area thus making twenty-eight plots each 33 by 66 feet and containing one-twentieth of an acre.

The soil is fairly uniform in quality throughout, it being a mixture of clay and gravel and at the outset was not of the best for garden purposes. Its texture has, however, been much improved by the annual application of stable manure at the rate of twenty tons per acre for the past ten years.


SERIES I.
Tomatoes
Plots I and II.
Tomatoes
Plot III
Beans and Corn
Plot IV.
SERIES II.
Limas
Plots I and II.
Salsify
Plot III.
Beans and Corn
Plot IV.
SERIES III.
Tomatoes
Plots I and II.
Tomatoes
Beans Plot III
Beans and Corn
Plot IV.
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Salsify, Corn,
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Plot I.
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Misc.
Plot III
Misc.
Plot IV.

EXPERIMENT AREA 1904.

Experiments in Crossing Sweet Corn.

One of the results of the experiments in the crossing of sweet corns has been the production of the "Voorhees Red." This new variety was shown in Plate 1 of the report of last year where four ears of it were displayed, with its male parent, the "Black Mexican" upon the left hand and an ear also of its mother plant, the "Egyptian" upon their right.

A history of the making of this variety by breeding and selection was given in Bulletin 170*, in which it was offered for free distribution to the people of New Jersey. Within the State the requests for this corn numbered two hundred and ninety-four (294) and to each of these a packet of fifty grains was sent including the following circular:

The sample of sweet corn contained herein represents a cross between the "Black Mexican" and "Egyptian." the former being the male and the latter the female parent. Both of these are old and well known varieties. The "Black Mexican," as the name implies, has grains that are characteristically black or dark blue, this color being one of the chief objections to a kind that is otherwise very acceptable. The "Egyptian" is a larger sort, somewhat later in coming to market size and has the grains white or amber-colored.

From these two varieites the new kind has been developed and is most easily characterized by the red (dark red when dry) color of the mature grains which are a handsome pink when in the green condition ready for the market.

The Director has kindly consented to his name being associated with it, and, therefore, it will be known as the Voorhees Red Sweet Corn.

It is desired that the one who receives this packet will plant the grains under favorable conditions for growth and, to preserve it unmixed, it should not be grown near any other variety of corn, whether sweet, field or pop sorts.

The Experiment Station, at which it was bred and from which it is distributed free, imposes but a single condition, namely, that one of the best ears gathered when fully mature be sent by mail to the Experiment Station. This is in order that a larger free distribution may be made the coming season.

BYRON D. HALSTED, Botanist.

New Brunswick, N. J., March 15th, 1904.

Notes from Growers of Voorhees Red Sweet Corn.

In order to obtain an impression of the value of the "Voorhees Red Sweet Corn" as a variety for general use the following four questions were sent to each of the 294 persons in the State who requested and received a sample last spring for trial:

1. Have you found the plants large, medium or small?
2. Were there one, two or more ears to the stalk?
3. Was the corn excellent, good, medium, fair or poor?
4. Were the rows eight, ten, twelve or fourteen?

In reply to the first question 25 considered it large, 83 medium and 6 small. It is seen that the variety may be considered medium-large.

In answer to the second question, 57 record it with one ear, 94 with two ears and 18 with three ears. This shows that the variety is more apt to have two than less or more ears.

As to the quality 45 reply excellent, 10 very good, 43 good, 8 medium, 12 fair and 1 poor. From this it is noted that the excellent and good far outnumber all the lower grades. There are, in fact, but few that consider the corn below good in quality.

In number of rows the record is as follows: 6 eight, 30 ten, 76 twelve, 26 fourteen, 3 sixteen rows. It is seen that twelve is the prevailing number.

The attempt to plant the small patch of a dozen or fifteen hills by itself led to many vicissitudes, in other words, it could not take a part of the regular garden with its superior soil and care but a place was sought elsewhere and the isolation brought many casualties which if catalogued here would make a long list. Here are a few: "A horse got in and destroyed nearly the whole crop, leaving but two ears to mature." Wishing to keep the corn pure I did not plant it until the 10th of June so that the other varieties would be done tasseling. Unfortunately a hen and brood of chickens nearly cleaned it up at the time it was coming up so that with the best of care afterward only succeeding in saving four stalks from which I have seed enough for another year." "I had just planted sweet corn in the garden and the only available place for it was near the woods. It came up well but was all eaten up before it got very large." "I planted it with other corn and when it matured I was unable to identify it." "Unfortunately the only ground available, that is, far enough away from other corn was rather too light for best results and the crop while fair is not as good as it should have been." "I have been sick all summer and it did not get the proper attention. I would like to keep the seed I have and try it next year." "Just before planting time I met with an accident and I had to trust to help that was not interested. I am in hopes of doing well by it next year." "A small striped worm played havoc with the plants." "A heavy wind storm blew it down flat when it was in the silk." "It was pillaged by children and not an ear was left." "Our Voorhees corn was destroyed by cattle so that we shall not have even a few grains to plant."

The following notes are more to the point: "Planted upon good ground it grows large and fine, two ears upon nearly all and three upon some stalks. Quality excellent!" "Stocky and thrifty; excellent; the best and sweetest corn we ever ate, superior to 'County Gentleman,' which I had considered the best." "The flavor was excellent, very sweet and tender, never ate better" "Seven or eight feet tall. Invariably at least two ears and sometimes three; excellent." "I think you have a good variety." "A good many of the stalks had two ears and some more and of very good quality." "I find it of very good quality and a very thrifty grower." "Large, somewhat less than 'Stowell's Evergreen' and excellent." "Of fine growth; not a plant that did not have two ears, some three and two with four; the quality excellent." "All right; eight feet high, two or more ears to stalk and quality excellent." "Mostly two ears to stalk and the corn was very tender and excellent." "Vigorous stalks, more than half had two ears; the quality was excellent and was fit for the table for a comparatively long time." "Smaller than 'Country Gentleman'; ears mainly two to a stalk, two had three ears; quality excellent." "The plant are medium but perfect in shape with the corn superior—very fine flavor." "Medium to large; mostly two ears; excellent." "The new corn is splendid." "Most had two ears to the stalk, some few three." "We consider it a very good corn, but not equal to the 'Country Gentleman'." "What corn I used I was greatly pleased with." "Uniform in size of stalk; two ears upon all but two stalks; excellent; from first to last being without difference except in being only a tinge of color on the earliest ears picked." "Medium size, uniformly two ears of good quality." "The plants were seven to eight feet high with two to three ears to the stalk." "We planted several varieties of sweet corn; the Voorhees was the best of all; it was excellent." "Generally two ears, quality excellent." "About evenly divided between one and two ears and almost entirely twelve rowed; quality excellent." "It grew splendidly and very quickly we ate one mess and thought it delicious, but the chickens got the rest except two ears saved for seed." "Planted June 20th and first picking September 22nd, it was very good." "Large; 47 stalks, 58 sound ears; good." "Fine growth, 46 stalks gave 21 with two ears; the quality the best we know of. We have 'Country Gentleman,' 'Stowell's Evergreen,' and other highly recommended sorts but 'Voorhees Red' exceeds them all in quality. It remains in an edible condition for a considerable period." "The stalks were very large and strong, but the corn was not as sweet as the pure "Black Mexican." "Large enough. My whole family agreed it was the most tender corn and best generally we ever had on our table." "We think it is a fine corn and will sell well."

Several reported for size, yield and quality in brief as follows: "Medium, one to two ears per stalk; excellent." Below is given a report of two correspondents in full:

First: "Received thirty grains of corn and planted three to a hill; hills four feet each way. The nearest plant of the corn variety 200 yards, a screen of trees intervening. Soil a rich deep loam. One application of sodium nitrate to the soil surface when the plants were well above ground. Plants grew nicely and had an even yield of medium well-formed ears—twelve and fourteen rows to the ear. Corn was milk-white while young, peculiarly sweet and tasty. As the corn grew older it became pink; at maturity the ear was varigated-pink and violet, becoming darker as it grew older.

The finer ears were selected and marked. A short time following our first (and only) cutting for the table, our neighbor's cow made a raid and was discovered in time to save a few hills. Fortunately one of the marked ears reached maturity. This will be mailed the A. C. E. Station."

Second: "The corn in question was planted on ground that had been planted to potatoes the previous year but had not been broken up prior to that for many years; no fertilizers were used as the soil was deemed rich without them; and unluckily the plants did not receive as much cultivation as the rest of the garden did.

The plants would average at least six feet in height and the yield was very abundant, ears of average size and of unsurpassed excellence. Of the thirty to forty ears reserved for seed a very few are mixed. The great majority of the ears were true in color to the last kernel."

A packet was sent to the horticulturist of the Experiment Stations with the view of testing the new corn under as wide a range of climatic and other conditions as possible. The following is a copy of the letter of transmissal to the Experiment Stations and gives in its closing paragraph he chief reason for the test:

Dear Professor:

In connection with the publication of Bulletin No. 170 upon Corn Breeding, now coming from the press, a sample of the Voorhees Red Sweet Corn is sent you, with the wish that you may find an opportunity to test it.

The inclosed circular was prepared for the instruction of the New Jersey crop-growers who may receive the corn; but if the Station Horticulturists send the single sample ear asked for it will give means of testing the comparative vitality of the grain from seed of common origin as grown in the various sections of this country. With best wishes I remain,

Yours sincerely,

At the time of preparing this portion of the report only a few samples have been received. The two ears from Professor Geo. C. Butz, of the Pennsylvania Experiment Station are of medium size, both ten-rowed, and with the grains of a uniform dark red color. Five ears were sent by Professor H. L. Price, of the Virginia Experiment Station, all of medium size, two ten-rowed and three twelve-rowed, solid red in color excepting one grain. The two ears from Professor W. F. Massey of the North Carolina Experiment Station were of fair length (five inches) not well filled out at the top, solid in color, but of a pale pink quite in contrast with the dark red of the Pennsylvania samples. A single ear from Professor F. H. Burnett of the Louisiana Experiment Station was of good shape but not well filled out and the grains all had a color that was much lighter pink than the North Carolina samples. So far as these four lots of samples go there is a strong indication that the shade of pink color may vary with the climatic conditions under which the corn is grown and that in the Southern states it may be much lighter than with us at the North.

Sample grains sent from Professor J. T. Higgins, of the Hawaiian Island Experiment Station are of a delicate shade of pink, almost the rose tint, which fact is in accord with the results obtained at widely separated localities in our own country.

From all of the most northern states like Maine, Minnesota, etc., the word has been received that the untimely frosts put an end to the experiment before any ears were large enough for seed. Although the season was unusually short in the northern belt of states the results show that a more rapidly maturing variety than the "Voorhees" needs to be used.

Crossing Corn—New Series.

In 1903 Plot 1, Series III, was planted with alternate rows of "Black Mexican" and "Country Gentleman." The first named variety as previously described is black-grained, medium in size of plant and in time for maturity and with eight rows of large grains upon the slender cob. It is of remarkably high quality but with the serious objection of being nearly black and, therefore, not

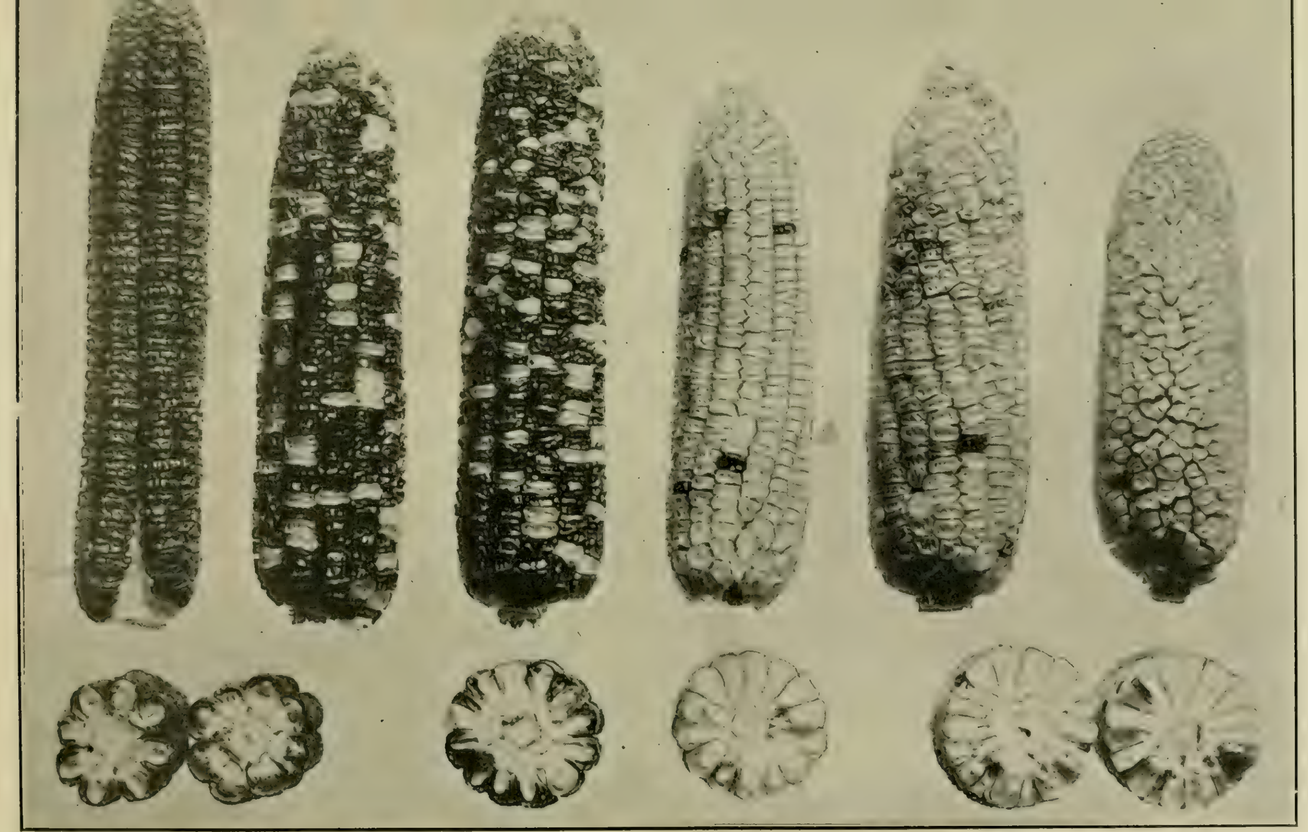

PLATE I. First year after cross between "Black Mexican" and "Country Gentleman" Corn. Upon the left is an ear and two sections of the "Mexican" parent and the "Gentleman" is similarly shown upon the right. The crosses are shown between them.

largely grown for the table. The "County Gentleman" upon the other hand is a white-grained sort somewhat larger in plant than the "Mexican" and ten days, or so, later in coming into season for the picking of the ears which have the long, pointed grains irregularly set upon the cob. It is seen that the two varieties, named above, are very unlike, in fact, it would be difficult to select two sorts of first-class sweet corn with fewer points in common.

It was strikingly noticeable last season that the "Country Gentleman" was abundantly fertilized by the "Mexican" while the reciprocal cross was apparently the rare exception. It was almost impossible to find an ear of the white sort without few or many dark grains while among all the "Mexican" ears only sufficient white grains could be found to plant but a few hills the present year. Hand pollination was successful with the "Gentleman" and ears were thus obtained that showed the cross in every grain. The color of these crossed grains was a shade of lead color and in this respect is quite different from the cross that developed into the "Voorhees Red."

Forty hills were planted this season with grains from the same hand-pollinated ear of "Mexican" upon "Gentleman." The ear from which the grains were taken is shown near the middle of plate II of the report for 1903. This block of hills standing by itself at one corner of the Experiment Area has shown a vigor of plant and evenness of growth that has been remarkable and being bred within themselves it is evident that each ear is very closely related to all the others. All came originally from the same two stalks that were bred together followed by a further breeding within the family of brothers and sisters, so to say. On the other hand the hills representing the scattered white grains upon several "Mexican" ears crossed naturally and widely showed a great range of vigor and in fact presented an unevenness of growth that contrasted strongly with the companion set of hills above described.

Plate I shows a set of six ears embracing the first generation of the "Mexican-Gentleman" crosses. The ear to the left is a typical specimen of the "Black Mexican" variety, it being slender eight-rowed and the grains of a uniform very dark color. At the opposite end—to the right, is an ear of the "Country Gentleman", is comparatively short, with the long white grains arranged without regard to definite rows. The contrast between the two parents is easily made by a study of these two ears.

The two ears nearest to the "Mexican" ear, and left of the middle of the plate are the result of the "Mexican" as a pollinizer upon the "Gentleman," that is, the grains from which these ears were produced came from an ear of "Gentleman" corn that had been artificially pollinated with the "Mexican" and the grains as before stated showed the immediate influence by being lead-colored instead of white as in the normal "Gentleman." The ear nearest to the "Mexican" is twelve-rowed from base to tip and represents those that are perhaps more nearly like the "Mexican" than the "Gentleman." The number of white (colorless) grains is 121 disposed in the twelve rows as follows: 10, 6, 11, 15, 7, 9, 15, 9, 10, 5, 12, 12. Twenty-five grains are tinged more or less with the dark and these also are quite evenly distributed over the whole ear, there being from one to five in each row. The black grains number 311 and were arranged among the white ones, as shown in the plate, with the rows as follows: 31, 28, 28, 27, 30, 24, 15, 24, 20, 29, 25, 30 There are nearly three colored grains to one of the white or colorless kernels. The next ear to the right approaches more the type of the "Gentleman" in general shape and in having the grains irregularly disposed in the upper half. Below the middle the rows are quite distinctly twelve in number. Here the mixture of white tinged and black grains is practically the same as in the ear to its left. This type of ear is very desirable in its size and shape and it remains to be determined what will be the result from planting the three colors of grains separately and developing a breed, if possible, from each by selection for a term of years.

A practical test of the corn as it became ready for the table this season demonstrated that the combination has produced a sweet corn of very high quality as might be expected from the reputation of the two parents used in the experiment.

Turning now to the reciprocal cross, namely, the "Country Gentleman" as the pollinator and the "Black Mexican" as the mother plant, quite different results are obtained in the first generation. It will be recalled that the white grains were very few upon the "Mexican" ears in last season's efforts to effect a cross. These white grains from several ears were planted by themselves and types of the results for this year are shown in the two ears to the right of the middle of the plate and left of the type of the male parent, the "Country Gentleman." The ear nearest the middle has its fourteen rows well defined, but otherwise there is not much resemblance to the mother parent ("Mexican") for the grains are long and narrow and white (colorless) with only ten exceptions. It is practically a "Gentleman" ear in its shape, it even having the bend common to its male parent that suggests the general outline of a fair-sized banana. The exposed ends of the grains are more regular in outline than upon the "Gentleman," a fact doubtless due to their being in well formed rows. There is a shade of amber in them all that might also serve to distinguish them from the "Gentleman" grains. The ear figured next to the left of the "Gentleman" is very much like the one already described and differs from it in being somewhat larger in diameter and having the fourteen rows, quite distinct at the base but much less so above the middle, and in this it is a further approach to the male parent. There are six grains that show the darkness that suggests the "Mexican" parentage.

The differences between the reciprocals in this cross are very striking. The mother plant in each case has given in the first generation an ear that resembles more the male than the female parent. In other words the two crossed ears upon the left of the middle of the plate are from a "Country Gentleman" ear fertilized by the "Black Mexican" and they would be classed with the latter rather than the former; in other words, they go with the male parent and three-fourths of the grains are of the same dark color and to be distinguished from the "Mexican" chiefly by their much greater length. In the same way the ears that have come from white grains in "Mexican" ears of last season have given ears this year that in their size and shape and the color of the grain, closely resemble the "Gentleman." In short, the male parent in both crosses has controlled to a large extent the character of the ear. Perhaps the most subject to remark is the almost entire removal of the dark color from "Black Mexican" grains in the first season after the cross, while in the reciprocal it is retained in nearly three-fourths of the kernels.

A glance at the sections of the cobs in the lower portion of the plate shows something of the differences in the size and shape of the cob and of grain between the parents and the two crosses. The pair to the left is of the "Mexican", the outer most showing the upper end of the section and the embryo (chit) of the grains while the obverse is seen to its right. The broad grains with their large embryo are quite in contrast with the corresponding pair from the "Gentleman" ear shown at the extreme right of the plate, with the long narrow irregular grains. In the "Mexican" the embryo is upon the upper side of the grain, that is, occupies a large part of the side toward the tip of the ear. The "Gentleman" grains observe this general rule only in part, as many of the kernels have their embryo in the opposite direction. The two sections shown in the plate are broken from the same ear and the chits are seen upon the end, the right one showing the section toward the stem (butt) end of the ear. The two crosses as seen in section indicate that cob and grains have the blended form and size of the two parents.

Experiments with Sweet Corn in 1904.

During the present season an extended study of the varieties of sweet corn was made with a view of breeding and selecting for better sorts, particularly for the early crop. To this end one hundred numbers have been grown. In some instances the same variety is represented by two or more numbers with the hope of detecting differences due to locality from which the seed was obtained. The following is the list, the varieties being arranged alphabetically as nearly as possible, followed by the source of the seed used, and various results obtained during the experiment:

In the list the letters under the head of "Mixing" are as follows: B, black; W, white; F, flint, and Y, yellow. And for "Maturity," VE, very early; E, early; ME, medium early; M, medium; L, late; ML, medium late; and VL, very late.

Number.	Name and Source of Seed.	No. of ears.	Av. Length. inches.	Rows.	Per Cent. Mixing.	Maturing.	Popularity.
1	Acme, Fmr.	6	4	10-12	12 B 5 W 1 W. B.	ME	65
2	Adams, Hlm.	6	5½	12-14	12 B 12 F	ME	2
3	Adams' Ex. Ey., Drr.	8	4	10-14	12 B 10 F	ME	
4	Aristocrat, Drr.	6	4½	8-10	10 B 10 F	ML	11
5	Asylum, Hlm.	6	6	8-12	10 B 15 F	ME	1
6	Banana, Fqr.	12	5	12-14	15 B 8 B 2 W. B.	ME	
7	Bryant, Jer.	12	6	8	5 W 2 Y	ME	1
8	Buck Mountain, J. & S.	17	5½	8-12	10 B 5 F	E	32
9	Burbank's Ey. Maine, Chl.	10	5	8-10	8 B 8 F	E	
10	Burbank's Maine, Raw.	8	6	8	8 B 4 F	M	44
11	Champion, Hen.	3	6½	12	6 B 3 F	ME	12
12	Chicago Market, Cur.	9	5½	8-12	8 B 2 F	ME	
13	Chicago Market, Vau.	4	4½	10-12	8 B	L	4
14	Columbus Market, Liv.	4	6	12	2 B	VE	43
15	Cory, Jerr.	11	3	8-10	2 B	E	21
16	Cory Ex. Ey. White, N. K.	10	4	8-10	5 B	E	31
17	Cory Ex. Ey. White, Bru.	10	3½	8-10	5 B	E	74
18	Cory White Cob, Hen.	8	3½	8-10	5 B	L	185
19	Country Gentleman, Exp.	9	4½	2	1 B	ME	129
20	Crosby Early, Drr.	4	4	10-12	8 B	ME	
21	Crosby Medium, Munson	4	2½	12	3 B	ME	1
22	Don, W. & D.	4	3	12	20 B 2 BF 3 WF 2 YF	VL	95
23	Egyptian, Fqr.	5	5	8-12	2 B	M	5
24	Eight Rowed, Thr.	3	7	8	8 B	M	39
25	Evergreen, Ferry's Ey., Fer.	2	5	16-24	2 B	L	1
26	Evergreen, Gold Coin, Hlm.	8	5	16-24	8 B	ML	
27	Evergreen, Striped, Iowa	12	5½	10-12	10 B 2 Y	E	
28	Evergreen, White, Bur.	8	4½	14-16	10 B	E	
29	Essex Early, Ggy.	8	4	12	8 B 1 Y	ME	3
30	Extra Ey. Eastern, Chl.	2	4	8	5 B	L	

Number.	Name and Source of Seed.	No. of ears.	Av. Length. inches.	Rows.	Per Cent. Mixing.	Maturing.	Popularity.
31	First in Market, Ham.	7	4	12-14	10 B 2 Y	E	95
32	First of All, Bur.	4	4	8-10	5 B	E	53
33	Fordhook Early, Bur.	5	3½	10	10 B 20 Y	E	16
34	Golden Bantam, Bur.	6	4	8	8 B	ME	
35	Golden Bantam, Mau	5	4	8	10 B	E	
36	Golden Dawn, Raw.	9	4½	8-10	8 B	ME	
37	Hammond's Best, Ham.	Failed.				?	
38	Harris' Ex. Ey., Hrs.	6	4	10-12	3 B	E	
39	Henderson, Hen.	7	6	8-14	10 B	M	8
40	Henderson, Hlm.	10	4½	12-14	10 B	M	
41	Hiawatha, Wd.	8	5	10-12	8 B	ML	
42	Hickox, Liv.	10	5½	12-14	10 B	M	69
43	Honey Dew, Chl.	8	4½	8-12	10 B	ML	3
44	Kendel's Ey. Giant, Hlm.	6	5½	8-10	10 B	ME	68
45	Kendel's Ey. Giant, Mau.	5	5½	10-12	40 B	ME	
46	Lackey, Ggy.	8	4	8-10	20 B	L	2
47	Livingston's Evergreen, R. C., Liv.	10	6½	8-10	10 B	M	1
48	Livingston's Evergreen, W. C., Liv.	9	6	8-10	10 B	M	1
49	Mammoth Early, Thr.	Failed.					62
50	Mammoth Late, Thr.	3	4½	16	1 B 2 F	VL	66
51	Marblehead Mammoth, Ggy.					VL	3
52	Market June, May	5	4	8-12	10 B 5 F	ME	1
53	Market Landreth's Ey., Lan.	4	4½	8-10	8 B 5 W 3 W B	ME	4
54	Market Oakview Ey., Fer.	Failed.				E	3
55	Maule's XX., Mau.	12	4	10-12	40 B 5 F	ME	1
56	Metropolitan, May	4	5½	10-12	15 B 5 F	ML	21
57	Metropolitan, Hen.	4	4½	8-12	5 B	ML	
58	Minnesota Early, Bru.	11	4	8	10 B 2 F	ME	142
59	Minnesota Early, Fmr.	6	5	8	8 B	ME	
60	Minnesota Early, N. K.	7	4	8-12	10 B 1 F	ME	
61	Moore's Concord, Thr.	Failed.				L	28
62	Ne Plus Ultra, Thr.	2	4		15 B 3 F	L	36

63	None-Such, Clark's, Hlm.	6	5	10	8 B 2 F		L	23
64	Old Colony, Fmr.	9	4½	10-12	8 B 1 F		M	43
65	Peep O'Day, N. K.	6	3½	8-10	2 B 2 F		VE	3
66	Perry's Hybrid, Thr.	11	4½	8-12	20 B		ME	120
67	Pharoh's Dream, Iow.	7	5½	12	10 B		VL	
68	Portland, Fmr.	3	4½	8-10	10 B		ME	2
69	Potter's Excelsior, Drr.	10	5	10-12	15 B		ME	50
70	Premier, Breck's, Brk.	9	4½	8-12	20 B		M	1
71	Premo, Hlm.	10	4	8-12	8 B 3 F		E	9
72	Premo, May	7	5	8	5 B		E	
73	Premo, Fmr.	7	3½	8-12	5 B		E	
74	Quincy Market, Ggy.	12	3	10-12	10 B		E	3
75	Roslyn Hybrid, Drr.	10	5	12-14	10 B		ML	20
76	Ruby, Bur.	4	4½	12	5 B 2 Y F		L	4
77	Russell's Prolific, Vk.	6	5½	10-12	20 B		ME	13
78	Shaker's Early, Hlm.	5	6	12-14	10-B		M	58
79	Sheffield Earliest, Bur.	5	5	10-12	8 B		L	5
80	Silver Coin, Liv.	Failed.					VL	1
81	Stabler's Extra Early, Bur.	5	3½	12-14	5 B 1 F		ME	8
82	Stabler's Early, Drr.	5	4½	12-16	20 B 5 F		ME	21
83	Stowell's Evergreen, Drr.	3	5	14	5 B		L	199
84	Stowell's Evergreen (East), Vau.	5	5½	12-14	3 B	3	L	
85	Stowell's Evergreen (West), Vau.	4	4	12-20	5 B 1 F		L	
86	Sunrise Early, Iowa	9	4	8-10	15 B 25 F		E	3
87	Table Earliest, Lan.	10	5½	8-12	10 B		VE	
88	Triumph, Drr.	7	6½	8-10	10 B 5 F		ML	22
89	Windsor Early, May	11	4	8-10	8 B 8 F		E	2
90	Zigzag, Hlm.	8	5½	14-16	15 B		ME	2
91	Zigzag Brecks, Brk.	7	5½		8 B 3 F		M	
92	Zigzag, Evergreen, Drr.	2	5		1 B 1 F		ME	44
93	"Musser," Musser	Failed.						E
94	"Garwood," Gardner	17	5½	12-16	20 B 3 Y			ME
95	Malakhov White, Hansen	11	4	8	1 B		VE	1
96	Malakhov Amber, Galligher	11	4½	8	5 B 1 F		VE	
97	"Hess," Hess	Omitted because of color.			Grown elsewhere.		ML	
98	White Mexican, Sox.	10	5½	8	3 B 3 F		ML	3
99	Black Mexican, Exp.	Omitted because of color.					ML	138

All of this list of corn was grown in a strip extending lengthwise of four plots. There were five rows running lengthwise of the strip and the middle one was planted with "Black Mexican," it being the only dark variety used. The planting of this row consisted in adding two grains to each hill upon May 3d, 11th, 21st, and 29th, that is, a total of eight grains extending from near the first to the last of May. This extension of time was given so as to accommodate the early medium and late varieties that were planted alongside. The kinds shown in the preceeding list were planted four hills each in short rows at right angles to the long "Mexican" row and with the latter making the third or middle hill in each variety row. Hill one of each row was planted on May 3d and hill two on May 11th, hill three, Mexican (given above), hill four, May 21st, and the hills making the fifth row on May 29th. While the intention was to cross artificially as desired, this arrangement secured conditions for much natural crossing among the ninety-nine numbers.

Notes Upon Yield of Sweet Corn.

By multiplying the number of ears and their average length together a fair comparison of the yield of each sort is obtained, particularly if note is made of the diameter of the ears as indicated by the rows in the third column. Those varieties that have produced forty or more inches of ears are as follows:

No.	Nane.	Total in.	Rows,
8	Buck Mountain	93½	12
94	"Garwood"	93½	16
7	Bryant	72	8
27	Stripped Evergreen	66	12
47	Liv. Evergreen red cob	65	10
6	Banana	62	zigzag
42	Hickox Improved	55	14
48	Liv. Evergreen white cob	54	10
9	Burbank's Early Maine	50	10
75	Roslyns' Hybrid	50	14
12	Chicago Market	49½	12
66	Perry's Hybrid	49½	12
96	Malakhov (amber)	49⅓	8
10	Burbank's Maine	48	8
55	Maule's XX	48	12
88	Triumph	45½	10
40	Henderson	45	14
58	Minnesota Early	44	8
90	Zigzag	44	2
95	Malakhov (white)	44	8
39	Henderson	42	14
36	Golden Dawn	40½	10
64	Old Colony	40½	12
70	Premier	40½	12
16	Cory Ex. Early	40	10
26	Evergreen Holmes Imp	40	24
41	Hiawatha	40	12
71	Premo	40	12

Considering the revised list in connection with the rows of grains upon the cob and selecting those with the number above ten the abreviated list becomes:

No.	Name.	Total in.	Rows.
94	"Garwood"	93½	16
8	Buck Mountain	93½	12
27	Striped Evergreen	66	12
6	Banana	60	zigzag
42	Hickox Improved	55	14
75	Roslyns' Hybrid	50	14
12	Chicago Market	49½	12
66	Perry's Hybrid	49½	12
55	Maule's XX	48	12
40	Henderson	45	14
90	Zigzag	44	zigzag
64	Old Colony	40½	12
70	Premier	40½	12
26	Evergreen Holmes Imp.	40	12
71	Premier	40	12

It goes without saying that these results are in no sense conclusive evidence for or against any variety. In the first place the small scale upon which the test was made precludes this. There were but four hills of each and one of these was in a border row planted late that did not do well. Again artificial crossing was carried on quite extensively, but not equally, with all the varieties, and this is a source of material disturbance of the results. The strip of corn ran across a piece of land where a manure heap had stood for six weeks in early spring. This, however, does not seem to have effected the results as the record numbers of the fifteen in the revised list taken are widely scattered through the list from Nos. 8 to 94.

The "Buck Mountain" (8) has a flint grain; all the others are of the true sweet or wrinkled type and chiefly of that group with the grains broad and not deep. However Nos. 26 and 27 are of the "Evergreen" type with long wedge shaped grains, particularly No. 26—a true evergreen. Nos. 6 and 90 may be classed with the latter in having long slim grains, at least much longer than broad.

Tendency to be Crossed Upon by the "Mexican."

All the varieties showed ears that had dark grains, which are assumed with much certainty, to be due to pollination by the "Black Mexican," which stood amidst them. The table shows that this mixing was not uniform in amount among the varieties but instead some sorts showed only one per cent., as in case of "Country Gentleman" (19) "Mammoth Late" (50) and "Zigzag" (92) while others showed as high as 40 per cent. as found in "Kendel's Giant" (45) and "Maule's XX" (55). The following varieties show 20 per cent.: "Don" (22), "Lackey" (46), "Perry's Hybrid" (66), "Premier" (66), "Russell's Prolific" (77), and "Stablers Early" (82).

This difference may be in part due to the season of blooming but this was in some measure overcome by the four plantings ten days apart of each variety including the "Mexican" used as the "breeder." By noting the time of coming into marketable size it is seen that two of the varieties which gave only one per cent. are "late" and very late" respectively. The two that gave forty and four, twenty per cent. are all "medium early." It may be seen that of two varieties standing side by side, namely, "Columbus" (14) and "Cory" (15) both with two per cent. of mixing the former is "late" and the latter "very early." Again "Peep o' Day" (65) "very early" and "Egyptian" (23) "very late" also gave two per cent. of dark grains. "Harris Extra Early" (38) and "Stowell's Evergreen" (84) a standard late sort, both gave three per cent. It is not unlikely, therefore, that some varieties may more readily mix with the "Mexican" than others. It is possible that there may be a crossing in this case and the result not be always apparent to the eye in the change of color in the grain.

It is observed that there was a mixing of the flint upon varieties Nos. 1 to 13 in which section were "Adams" (2), "Adams' Extra Early" (3), "Bryant" (7), and "Buck Mountain" (8), all of the flint group the "Bryant" being yellow. "Banana" (6) showed as high as fifteen per cent. of the flint, "Acme" (1) twelve and "Burbank's Maine" (9) eight per cent. The yellow of the "Bryant" was found in "Buck Mountain" (2 per cent.) and "Adams' Extra Early" (2 per cent.). The "Bryant" showed white (5 per cent.), black (8 per cent.), and wrinkled black (2 per cent.) while "Adams" (2) gave black (12 per cent.), wrinkled (5 per cent.) and wrinkled black (1 per cent.)

The "Egyptian" (23) stands out alone in its region of the table as showing in addition to its two per cent of black, black flint (2 per cent.) white flint (3 per cent.), and yellow flint (2 per cent.)

In the region of the "Golden Bantams" (34-35) and "Golden Dawn" (36), the "Fordhook" (33) shows twenty per cent. of yellow while "Essex Early" (29) has 10 per cent. and "First in Market" (31) only 2 per cent.

From No. 50 to No. 65 there is an out-cropping of flint crossing due to the presence of "Landreth's Market" (53) which is flint of medium earliness. It is seen that the percentage of mixing is low, not rising above five per cent. in the varieties nearest to No. 53. There were two ears of solid flint in the row of "Minnesota Early" (59) which is not easily accounted for in the way of ordinary mixing. The "Landreth" had upon its ears of flint corn, black (8 per cent.) wrinkled (5 per cent.) and three per cent. of wrinkled black.

In the region of "Earliest Table" (87) another flint sort, which is very early and itself gave ten per cent. of black grains from the "Mexican" breeder, there is another belt showing the mixing of the smooth grains among the ordinary wrinkled ones. In a nearest neighbor "Sunrise" (86) this mixing reached 25 per cent., but elsewhere it ranged from ten per cent. in "Stablers" (81) to one in "Stowells" (85), "Zigzig" (92) and "Malakhov" (96).

It is noted that the latter half of the whole list of varieties there are only two sorts that show any of the yellow, namely, "Ruby" (76) two per cent. of yellow flint apparently from "Bryant" (7) among the first in the list and about seventy yards away, and three per cent. in "Garwood" which, being wrinkled grains, may have come from Numbers 34 to 36.

The experiment suggests that beyond fifty feet there is no serious danger of corn mixing provided there is corn covering the intervening space. Possibly under other conditions than those obtaining in this test with strong wind blowing constantly during blooming time the results might be quite different.

A Mosaic in Corn.

An ear taken from the hill in the "Banana" row had the following surroundings:

The four hills of "Banana" sweet corn stood two upon its right of and two upon its left while parallel with the "Banana" upon one side were the four hills of the "Asylum," and the four hills of the "Bryant" upon the other. The next beyond the "Asylum" was the "Aristocrat." In other words the ear was grown close to a yellow flint, the "Bryant," and a pink, sweet, the "Aristocrat." Next beyond the 'Aristocrat" was a dent "Adams Extra Early", while upon the opposite side and next beyond the "Bryant" was the white flint "Buck Mountain." As a result of this proximity the sample ear in question twelve-rowed at the base, the grains being without order at and above the middle, showed the following variety of grains:

Yellow flint—"Bryant" pollination?	1 per cent.
Blackish wrinkled—"Black Mexican" pollination?	15 " "
White Wrinkled—"Banana," etc.?	20 " "
Blackish flint—"Buck Mountain," X "Mexican"?	20 " "
White flint—"Buck Mountain"?	15 " "
Blackish dent—"Adams" X "Mexican"?	10 " "
Dent—"Adams"?	10 " "
Pink—"Aristocrat"?	4 " "
Pink dent—"Aristocrat," X "Adams"?	5 " "

Among the Best Varieties of Sweet Corn.

The sweet corns may be grouped into the (1) very early (2) early, (3) medium early, (4) medium, (5) medium late, (6) late, and (7) very late. Of the first group "Cory" (15), "Peep o' Day" (65), and "Malakhov" (95) may be taken as good types. These very early corns are small in plant and ear their chief merit being earliness. The experience of the past year does not demonstrate the need of growing any of the flint sorts in order to enjoy the satisfaction of having very early pickings of corn. The reports upon the "Malakhov" from various parts of the State (given elsewhere) indicate that it has much merit as a sweet early corn. It may be possible to increase its size and yield materially by crossing with a large and somewhat later variety as "Premo" or "Quincy Market" and not lose much in point of earliness.

In addition to the two last mentioned varieties the "Burbank" (10), "Early Sunrise" (86), and "Early Windsor" (89) may be mentioned among the second or "early" group that did well for that class of corn.

The "medium early" include a long list of varieties and it is somewhat difficult to select, but the following are satisfactory: "Banana" (6)—a zigzag type like the "County Gentleman," but, of course, much earlier; "Chicago Market" (12) which makes a good-shaped ear, "Kendel's Early Giant" (44) are apparently well-bred type easily distinguished. "Maule's XX" (55) has a heavy ear as shown in the plate of the varieties, while "Minnesota" (58) has a rather small ear. Others to be named here are "Perry's Hybrid" (66) and "Potter's Excelsior" (69) substantial sorts that evince good breeding and "Zigzag Evergreen" (92) and "Garwood" (94), the latter not a commercial variety but showing so much uniformity in plant and product and so fine a yield that under its tenative name it seems worthy of a place in the medium early list.

Under "medium" may be mentioned, "Henderson" (39), "Hickox" (42), "Old Colony" (64), and "Black Mexican" (99). The last named, while objectionably black and only eight rowed as a rule, has a richness of flavor and productiveness that makes this very distinct variety quite popular. The other three sorts are with large ears bearing many rows of grains and all come well up in the list of those varieties producing a good crop.

The "medium late" claims the following as among the best varieties. "Champion" (11), "Striped Evergreen" (27), Metropolitan" (56) and "Roslyn Hybrid" (75). These are all pro-

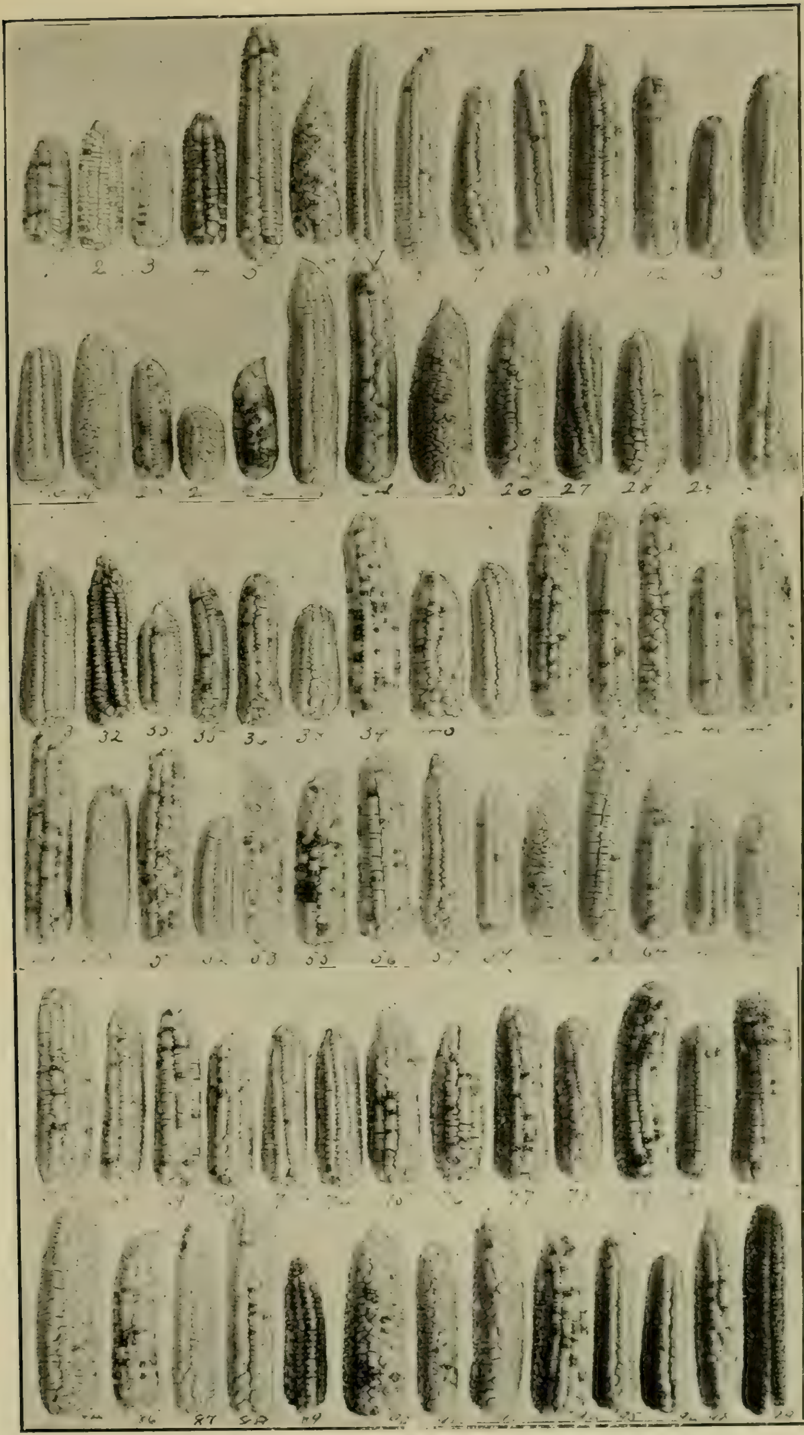
2
3
26
27
28
32
33
53
55
56
86
87
89

PLATE II. Sample Ears from the varieties of sweet corn grown in the trial plots during 1904. The reader will associate the numbers with those in table of a neighboring page.

ducers of ears of large diameter and many rows of long grains. The "Metropolitan" had particularly fine ears and an average specimen is shown in plate II.

Of the somewhat shorter list of the "late" varieties only "Country Gentleman" *(19)* and "Stowell's Evergreen" *(83)* are here mentioned, but the initial letter in the table under "date of maturity" will indicate that seven other sorts are classed here.

Popularity of Varieties.

The meaning of the term popularity as here used is determined from Bulletin No. 22* of the Bureau of Plant Industry. In its preparation the author has listed with each variety of vegetable the names of all the seedsmen *(266)* issuing catalogues in the United States and Canada. From this bulletin it is determined, as shown in the above tabulation, that some varieties are sold by a larger number of dealers than others; thus the "Don" *(22)* is listed in only one catalogue while the "Egyptian" *(23)* is offered for sale by ninety-five seedsmen. It is seen that the following seventeen head the list namely:

Name.	Total.	Name.	Total.
Stowell's Evergreen	199	Hickox	69
Country Gentleman	185	Kendel's Ey. Giant	68
Minnesota Early	142	Mammoth Late	66
Black Mexican	138	Adams	65
Crosby Early	129	Mammoth Early	62
Perry's Hybrid	120	Shaker's Early	58
Adams' Extra Early	95	First of All	53
Egyptian	95	Potter's Excelsior	50
Cory White Cob	74		

This list does not agree very closely with the previous one, showing those with the largest yields in our trials.

Experiment With Conspiciously Colored Varieties.

Upon a block of land kindly loaned for the purpose by the Horticultural Department of the State Experiment Station further experiments were carried on with sweet corn. There were five strips, between small orchard trees, that were devoted to sweet corn, each having four rows of seventy-five hills each. One of the middle rows was planted entirely with a single sort called the "breeder," while along side of it were the other three rows, each made up of a hill each of seventy-five varieties. The

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* Bulletin 21, U. S. Department of Agriculture, Bureau of Plant Industry. List of American Varieties of Vegetables for the Years 1901 and 1902 by W. W. Tracy, Jr.

"breeders" were, for strip 1, "Aristocrat;" strip 2, "Adams;" strip 3, "Striped Evergreen;" strip 4, "Golden Bantam;" strip 5, a sort called "Hess." The "Aristocrat" (4) is a sweet early variety, with pinkish grain; "Adams" (3) is an early white dent; "Striped Evergreen" (27), as the name indicates, is a sweet corn with the grains marked with pink stripes; "Golden Bantam" (34) is an early yellow, and the so-called "Hess" is a red sweet corn with red cob and husks. These "breeders" were all selected on account of their striking peculiarities, while the sorts planted alongside of them were sweet corns of the common white type.

In the first strip where the seventy-five white varieties were alongside of the "Aristocrat" the harvest showed that the pink "breeder" had very feeble power to impress its color upon the grains of neighboring ears and reciprocally the white grains were nearly absent upon the "Aristocrat" ears.

The second strip had as its "breeder" a variety with large flinty grains with a dent when mature. Here the sweet sorts alongside showed a marked influence from this sort, as their grains were many of them smooth. The "Adam's" ears showed no grains that were wrinkled from the crossing with the sweet varieties.

Strip 3, where the "Striped Evergreen" (27) was the "breeder," gave no indication that this variety had any influence upon the neighboring sorts. The ear of the "breeder" showed some grains that were tinged with yellow as a result of crossing with the "Golden Bantam" in an adjoining strip. It was not expected that the immediate neighbors, all being white, would noticeably effect the striped grains in the breeder, but it is worthy of remark that the "breeder" did not develop some stripes even though few upon the white sorts that grew along side.

The early yellow "Golden Bantam" (34) was able to impress itself freely upon its neighbors, and, as remarked above, its influence went beyond its own strip of corn. The crossing here was not reciprocal in the sense that there were no white grains upon the small yellow ears of the "breeder." Like the "Black Mexican," this is a distinct sort that breeds freely upon other variety, or at least its impress is evident, while with other sorts the crossing may be as effective, but not distinguished at once with the eye.

The last strip had the most striking "breeder" of all, in the deep red grains taken from a solid red ear kindly sent to the department by a Mr. D. W. Hess, of this State. In this case, there was no instance of the red color being impressed upon any of the many neighboring white varieties, and, contrariwise, no white or mixed grains could be detected upon the red ears produced by the "Hess." If there is any crossing, it remains for the next crop to bring it to light. It is interesting to add that many of the "Hess" stalks produced ears with white husks, cob and grains—in other words, solid white ears in striking contrast with those that were red in all these features developed upon neighboring stalks in the same row, all from red grains from a single solid red ear. A very few of the ears were neither red nor white, but had the grains tinged slightly with the red color. The idea that this is a "sport" finds evidence in the above facts.

Proposed Classification of Sweet Corn.

Below is given a preliminary classification of the varieties of sweet corn grown upon the Experiment area during the present season.

- **A** Kernels white, wrinkled.
  - **B** Rows more or less distinct.
    - **C** Cobs and husks reddish purple.
      - Ruby (76).
    - **CC** Cob red.
      - **D** Rows usually eight.
        - **E** Season early.
          - Windsor (89).
        - **EE** Season medium.
          - Livingston's Evergreen, red cob (47).
      - **DD** Rows generally more than eight.
        - **E** Season medium early.
          - Acme (1).
          - Perry's Hybrid (66).
        - **EE** Season late.
          - **F** Ears rather short.
            - Non such (63).
          - **FF** Ears long and slim.
            - Hiawatha (41).
    - **CCC** Cob white.
      - **D** Season early.
        - **E** Rows usually eight.
          - Cory (15–18).
          - Lackey (46).
          - Early Maine (9-10).
          - Peep o'Day (65).
          - Early Sunrise (86).
          - Malakhov (95, 96).
        - **EE** Rows generally more than eight.
          - **F** Ears cylindrical or nearly so.
            - Essex Earley (29).
            - First in Market (31).
          - **FF** Ears tapering.
            - **G** Kernels longer than broad.
              - Harris' Extra Early (38)

- **GG** Kernels generally not longer than broad.
  - Eastern Extra Early (30).
  - Fordhook Early (30).
  - June market (52).
  - Premo (71-73).
  - Quincy Market (74).
- **DD** Season medium.
  - **EE** Rows usually eight.
    - **F** Ears small.
      - Chicago Market (12, 13).
      - Minnesota (58-60).
      - White Mexican (98).
    - **E** Ears large.
      - Eight rowed (24).
      - Livingston's Evergreen, white cob (48).
      - Triumph (88).
  - **EE** Rows generally more than eight.
    - **F** Ears cylindrical or nearly so.
      - Henderson (39, 40).
      - Potter's Excelsior (69).
    - **FF** Ears tapering.
      - **G** Kernels longer than broad.
        - Hickox (42).
        - Old Colony (64).
        - Portland (68).
        - Roslyn Hybrid (75).
        - Russell's Prolific (77).
      - **GG** Kernels generally not longer than broad.
        - **H** Kernels small or medium, wrinkled.
          - Crosby (20).
          - Don (22).
          - Honey Dew (43).
          - Maule's XX (55).
          - Shakers' Early (78).
        - **HH** Kernels large and thin, wrinkled.
          - Asylum (57).
          - Champion (11).
          - Metropolitan (56, 57).
          - Premier (70).
        - **HHH** Kernels large and thick, slightly wrinkled
          - Kendel's Early.
          - Giant (44, 45).
- **DDD** Season late.
  - **E** Kernels longer than broad.
    - Ferry's Evergreen (25).
    - Gold Coin Evergreen (26).
    - White Evergreen (28).
    - Mammoth Late (50).
    - Stowell's Evergreen (83-85).
  - **EE** Kernels generally not longer than broad.
    - Columbus Market (14).
    - Egyptian (23).
    - Pharoah's Dream (67).
    - Moore's Concord (61).
    - Sheffield (79).
    - Silver Coin (80).

- **BB** Rows not Distinct.
  - **C** Kernels small.

      - **D** Season medium early.
        - Banana (6).
      - **DD** Season medium or late.
        - Country Gentleman (19).
        - Ne Plus Ultra (62).
        - Zigzag (91).
    - **CC** Kernels large.
      - Zigzag (90).
      - Zigzag Evergreen (92).
- **AA** Kernels colored, wrinkled.
  - **B** Color dark amber.
    - Aristocrat (4).
    - First of All. (32).
  - **BB** Color red.
    - Voorhees.
  - **BBB** Color black.
    - Black Mexican (99).
  - **BBBB** Color yellow.
    - Golden Bantam (34, 35).
    - Golden Dawn (36).
  - **BBBBB** Color white striped with crimson.
    - Striped Evergreen (27).
- **AAA** Kernels flinty.
  - **B** Kernels white.
    - **C** Rows usually eight.
      - Buck Mountain (8).
      - Landreth's Early Market (53).
      - Landreth's Earliest Table (87).
    - **CC** Rows generally more than eight.
      - Adams (2).
      - Adams' Extra Early (3).
  - **BB** Kernels yellow.
    - Bryant (7).

Field Notes Upon Sweet Corn.

The following notes are kindly furnished by Mr. J. K. Shaw, who had the immediate charge of the field experiments with corn:

The foregoing preliminary classification of sweet corns is based on the somewhat careful study of the dry ears of the varieties grown in the Experimental Gardens during the past season. In some cases a lack of material has made it uncertain just where to place a variety under consideration. A natural classification, however desirable, is not attempted at the present time.

The sweet corns, as a whole, are easily separated into three grand divisions, namely: (1) Those with the kernels of the common amber white color; (2) those of various other colors, and (3) those flint corns which on account of their earliness and productiveness are much grown for market purposes. The first and largest division is separated into two groups, depending upon the arrangement of the grains, whether in rows or zigzag. The corns of the first group sometimes show more or less of the zigzag arrangement, and occasionally regular rows appear in the these corns, but, as a whole, the line of separation is well defined.

The first division is separated into three sub-divisions, according to the color of the cob, whether it is a purple, red or white. The first includes only the "Ruby" (76), or "Improved Ruby," as it is often called. This is a marked variety, easily distinguished by its deep purple husks, sheaths and cob. With us it did not show especial merit. In the second sub-division is the "Windsor" (89), an early corn of considerable merit. It resembles the "Cory" (red cob) in its appearance. Distinguished from this by its later period of maturity and long tapering ears is "Livingston's Evergreen" (red cob) (47). It is not a true "Evergreen," as indicated by the shape of its grains, which are large and broad. The second class, those having more than eight rows, is divided into two sub-classes, according to season, as before, the first being "medium early" and the second "late." In the first are "Acme" (1) and "Perry's Hybrid" (66). These resemble each other and both sometimes show ears with amber grains. "Perry's Hybrid" gave the larger yield, but this may have been due to a better situation. The second sub-class, "season late," includes two varieties which are separated according to the length of ear; "Hiawatha" (41), having ears noticeably longer than "Non Such" (63). The former is a new sort from Virginia. Both are promising varieties.

The third sub-division includes varieties having white cobs and is divided as before, according to the season, into "early," "medium" and "late" sorts. The early varieties are again divided according to the number of rows, whether eight or more than eight. The first sub-class includes "Cory" (15-18), "Lackey" (41), "Burbank's Early Maine" (9, 10), "Peep o' Day" (65), "Early Sunrise" (86) and "Malakhov" (95, 96). The "Cory" is an old standard among the early corns, and it is doubtful if any of the newer sorts surpass the best strains of this variety. It is, as is to be expected, somewhat variable, and care should be taken by the grower to secure a good strain of seed. The "Cory" (15) from Jerrard, of Maine, was the first sort in the field to produce an ear fit for boiling. The "Lackey" is a New England corn of merit. "Burbank's Early Maine" seemed to be a variety of considerable value. It is not as early as the "Cory," but the ears are longer, and with us it was more productive. "Peep o' Day" is a small early corn from the Northwest. It proved to be as early as the "Cory," but the ears were much smaller. It appears to be a development of the "Minnesota," which variety is considered further on. The "Early Sunrise" is a new sort, said to have originated in Western Iowa. It resembles "Premo," but with ears more pointed and not so well filled out. It seems to be of value. The "Malakhov" is a variety of Russian origin which has been offered by a few seedsmen in this country. It is a very early variety with ears somewhat resembling the "Peep o' Day" but larger and better filled out. There are two strains the "white" and the "amber" which differ slightly in color.

The second sub-class, sorts having more than eight rows, is again divided into two groups, according to the shape of the ear, whether cylindrical or tapering. In the first group are "Essex Early" (29) and "First in Market" (31). The former made the better showing, and is a desirable early corn. The next group, those with tapering ears, is divided according to the shape of the kernels, some being longer than broad, and others not longer than broad. In the first group is "Harris Extra Early" (38). The shape of the grains in this variety is not marked or constant, as in some other sorts. In the second sub-group are "Eastern Extra Early" (30), "June Market" (52), "Premo" (71-73) and "Quincy Market" (74). With us, "Premo" made the best showing of this group. Its ears are of good shape, and well filled out. It resembles "Minnesota," but it is larger and earlier. It is a comparatively new sort, introduced by Holmes in 1900. "Quincy Market" was somewhat inferior to "Premo" in appearance, but still a desirable variety. "June Market" was sent out as a very early variety, but with us it hardly bore out this claim, though it is but fair to say that its situation on the end of the plot was unfavorable. "Eastern Extra Early" and "Fordhook Early" were much alike.

The second class, white cob corns of medium season, is divided according to the number of rows. The first sub-class, those having eight rows, is again divided on the size of the ears, whether large or small. The small-eared sorts are "Chicago Market" 12, 13), "Minnesota" (58-60) and "White Mexican" (98). "Minnesota" is the best known of these, being an old sort, which has probably given rise to several of the newer varieties of early sweet corn. With us it was not especially early, and was inferior to some of the newer kinds. "Chicago Market" somewhat resembled it, but was larger and better. The "White Mexican" is like the old "Black Mexican" in appearance, except in the color of the grains, which is white. The next group, having "ears large," includes "Eight Rowed" (24), "Livingston's Evergreen" (white cob) (48) and "Triumph" (88). These are all later in season than the last group considered. "Triumph" is the best known of these. "Livingston's Evergreen" is a white cob form of "Livingston's Evergreen" (red cob) (47). These sorts are at a disadvantage for the market, as the preference is for an ear with twelve or more rows. The second sub-class, those sorts having more than eight rows, contains a large number of varieties, and is divided on the shape of the ears. Two sorts have cylindrical ears, namely, "Henderson" (39, 40) and "Potter's Excelsior" (69). Both are desirable for mid-season, the "Henderson" leading with us. The second group, those having ears tapering, is sub-divided upon the shape of the kernels, the first sub-group having kernels longer than broad and the second not longer than broad. The first contains "Hickox" (42), "Old Colony" (64), "Portland" (68), "Roslyn Hybrid" (75) and "Russell's Prolific" (77). "Old Colony" is smaller than "Hickok," but both are desirable varieties. "Roslyn Hybrid" is later in season, and bears considerable resemblance to the "Evergreen" sorts. The second sub-group is divided according to the size and appearance of the kernels. Those having the usual type of kernels but rather small are "Crosby" (20, 21), "Don" (22), "Honey Dew" (43), "Maule's XX" (55) and "Shaker's Early" (78). "Crosby" is an old standard medium early variety, often grown to follow "Cory." One strain of seed of this variety, called "Crosby Medium" (21), was from Professor Munson, of Maine, and was a selected strain of the famous "Maine sweet corn" for canning. It produced a good number of short but well filled ears. The "Don" is a new sort that with us did not exhibit especial merit. "Maule's XX" was fairly prolific, but with ears rather short for a medium early corn. The varieties having grains noticeably larger than the last are "Asylum" (5), "Champion" (11), "Metropolitan" (56, 57) and "Premier" (70). "Champion" is, perhaps, the most popular of these. The ears are large and well shaped. "Asylum" sometimes called "Early Mammoth," is much like "Champion." On some ears the rows were more or less zigzag. "Metropolitan" has longer and slimmer ears, and made a good showing. "Premier" proved to be fairly productive, but the ears were rather short. "Kendel's Early Giant" (44, 45) is easily distinguished from the foregoing by the peculiar appearance of the grains which are large and thick, and not as much shriveled as are the true sweet corns. It seems to be less sweet than most of the genuine sweet corns. These facts suggest that it may be a cross between a true sweet and a flint corn.

The third class, the "late" corns, is divided upon the shape of the kernels, the first sub-class having this longer than broad, and includes "Ferry's Evergreen" (25), "Gold Coin Evergreen (26), "White Evergreen" (28), "Mammoth Late" (50) and "Stowell's Evergreen" (83-85). The first three may have descended from the last variety named, which, it has been said, came from a cross of a true sweet with a dent field corn. It leads all varieties in popularity, as shown by the table, and is much grown for forage, as well as for the market. "Gold Coin Evergreen" produced rather larger ears than "Stowell's. "White Evergreen" is, as its name indicates, somewhat lighter in color than the other "Evergreens." The second sub-class of the "late" corns includes "Columbus Market" (14), "Egyptian" (23), "Pharaoh's Dream" (67), "Moore's Concord" (61), "Sheffield" (79) and "Silver Coin" (80). Probably the best known of these is "Egyptian," which is a very late variety, bearing good-sized ears of twelve or more rows.

The second division, those with zigzag grains, is divided into two sub-divisions, the first of which are of the true "Country Gentleman" type, and the second posibly a cross of this with an "Evergreen" corn. The first sub-division is separated into two classes, according to season. "Banana" (6) is about two weeks earlier than "Country Gentleman," with ears rather more pointed. It is a good productive variety. The second class contains "Country Gentleman" (19), "Ne Plus Ultra" (62) and "Zigzag" (91). The first is a well-known late sort of excellent quality. "Ne Plus Ultra" is identical, or nearly so, and "Zigzag" is very much the same, but with us appeared to be somewhat earlier in season. The second sub-division, having "kernels large," includes "Zigzag" (90) and "Zigzag Evergreen" (92), which are very similar in appearance, and, while the arrangement of the kernels resembles that of "Country Gentleman," the size is much larger.

The second grand division includes those sorts having wrinkled kernels of various colors other than the usual amber white, and is easily separable into five divisions, according to the color of the kernels. The first division, with kernels decidedly darker than the great majority of sweet corns, includes "Aristocrat" (4) and "First of All" (32). The first is a new medium early sort, introduced by Dreer in 1903. The ears are of fair size, with grains broad and flat. "First of All" has more slender ears and smaller kernels. Under "color red" is the "Voorhees," a variety originated at this Station from a cross of the "Black Mexican" on the "Egyptian." Under "color black" is the "Black Mexican" (99), referred to above, an excellent eight-rowed, medium season variety, much liked by those who do not object to its dark color. We have two yellow corns, the "Golden Bantam" (34, 35) and the "Golden Dawn" (36). Their color and taste suggest them to be the result of a cross of a small sweet with a yellow field corn. "Golden Bantam" is very small both in stalk and ear, and medium early in season, while "Golden Dawn" is somewhat larger and later. The "Striped Evergreen" (27) is a peculiar sort, in that the grains are longitudinally striped with narrow bands of bright carmine. Rarely a pure red kernel appeared, and there were a few solid red ears. The striping varied in amount, and frequently failed to appear, leaving the ear pure white.

The last of the three grand divisions, comprising the flint "sweet corns," is separated into two divisions, according to color, the first of which is further divided upon the number of rows. The first sub-division of eight-rowed flint corns contains "Buck Mountain" (8), "Landreth's Early Market" (53) and "Landreth's Earliest Table" (87). "Buck Mountain" is medium early in season, and produces ears of good length. "Landreth's Early Market" is about the same in season, but the ears are much smaller. "Landreth's Earliest Table" resembles "Buck Mountain" in appearance, but is smaller, and one of the earliest corns grown. The "Adams" (2), or "Early Adams," and "Adams' Extra Early" (3) are the best known of the flint corns. The former is large and rather late, with a tendency to produce dent kernels. "Adams' Extra Early" is a small early corn, with large short ears, and "Bryant" (7), a small eight-rowed early yellow flint.

The Malakhov Sweet Corn.

Professor N. E. Hansen, Horticulturist of the South Dakota Experiment Station, while in Russia, procured, among other plants and seeds, a sweet corn that bears the name of "Malakhov." It has been grown by the introducer for some years past, and this spring a package of it was obtained through the courtesy of the U. S. Department of Agriculture, and bearing the number of "9573—(white)." It is 95 of our list. Packets containing fifty seeds each were sent out to two or more repre-

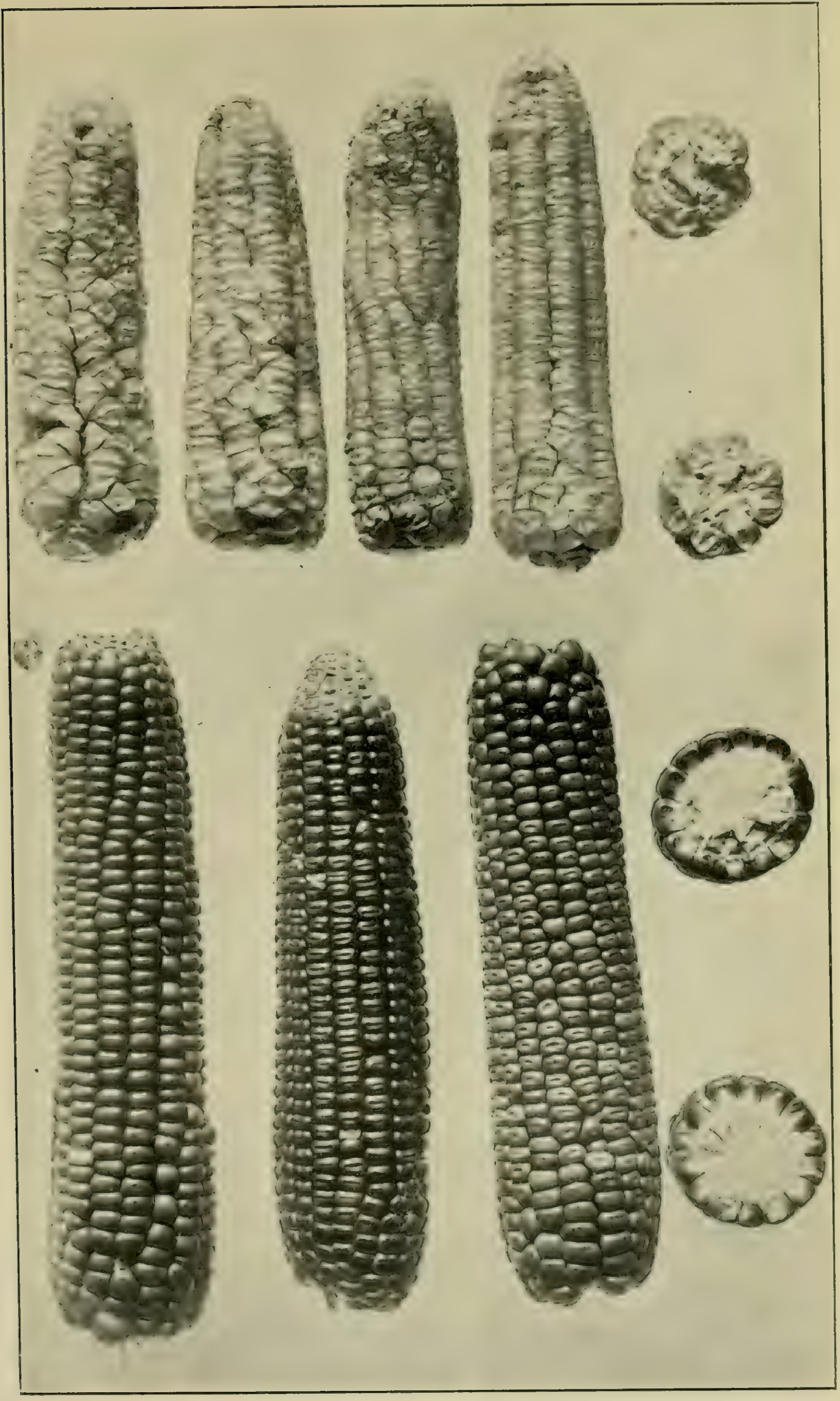


PLATE III. Malakhor Sweet Corn with sections of ears in the upper portion of plate. The lower ears are of Apache Corn long grown by the Indians in New Mexico.

sentative men in each Congressional district of the State, while a quantity was grown upon our own experiment grounds.

All reports sent in agree that the plants are small, one stating the average height to be 4½ feet. The number of ears to a stalk is ranged from one to four. As to quality, the reports are usually excellent or good. The number of rows to the ear is almost invariably eight. Several of those who grew the corn sent sample ears to the Experiment Station.

Below is given some of the remarks submitted to us:

"We tried one small mess of it, and it was pronounced very sweet. It grows very quickly." "Planted it on the 22d of May, not expecting to see any results, but, to my surprise, it was up in a few days, and grew rapidly, soon tasselling out, and ears setting while it was only about three feet high. We had one meal from it the first by two weeks of any other sort—near the 4th of July. Shall give it another trial." "Planted May 31st, and used for table August 5th. It can be planted closely, and get a fair yield of early corn." "It is a very early kind of corn, as I planted some of my own at the same time, and the 'Malakhov' came two weeks earlier. The stalks I do not think were over two and one half feet tall!" "I put it on my table sixty days from planting, and it was plenty old enough. It had excellent ears, of good quality." "The corn is too small to be profitable for market, but it is valuable for the home garden on account of its earliness."

Upon our own grounds, it gave ears in fair number, that averaged four inches in length. They had the rows always to the number of eight. Two crops might be grown during a single season.

Alongside of the above we grew a few hills of another "Malakhov" corn (96), also received from the U. S. Department of Agriculture, and under the list number of "9357—(amber grain)", grown by Upton Galligher. The two varieties grew nearly the same with us, and the color of the dried grain is practically alike in both. The last named has the ear somewhat longer and more even in diameter throughout.

Plate III. shows two of the ears of the "amber" kind (96) upon the left hand of the upper row, while two of the "white" (95) are shown upon the right hand. The depth of the grain is indicated in the two sectional views of an ear at the extreme right.

A Second Crop of Sweet Corn.

Mature ears were gathered upon some of the earliest varieties, and a small plot of ground was planted with grains from each upon July 27th. This set of quick-growing corns grew fairly well through the early autumn, and had it not been for the untimely frosts would doubtless have yielded returns comparable with the first crop. Upon October 24th a few ears with grains large enough to eat were gathered from "First of All" (32), "Peep o' Day" (65) and "Landreth's Table" (87). The size of the stalks and the output of marketable green ears was very small, the average height of plant being two and one-half feet and length of ear three inches.

No seed matured from any variety, thus prohibiting a test of the value of a second crop for future planting.

The Apache Corn.

Through the kindness of Professor Fabian Garcia, Horticulturist of the New Mexico Experiment Station, a packet of corn was obtained last spring of a kind that has been grown by the Indians of the arid regions of the Southwest for a long time, and known as the "Apache" Corn. The grains, as they were received, excited comment because of their peculiar bluish color.

A small quantity of this corn was planted in land adjoining the experiment plots, and where the soil had not received any manure for many years. With the unfavorable conditions of soil and a wet growing season, quite opposite to that of its ancestors had been accustomed to, the stalks grew to the height of from eight to nine feet, and produced ears averaging eight inches in length and nearly two inches in thickness, with rows varying from fourteen to eighteen of closely set dark grains.

This corn may be of value as a breeder with the Eastern sorts, particularly in those regions of the State where the soil is sandy and ordinary corn often suffers from dry spells. Its having been grown for long in an arid region may have developed desirable qualities now hidden from view.

The seed that has been grown here is ready for distribution to those who may desire to make a trial of it, either alone or to breed with other field varieties.

The lower portion of Plate III. shows three ears of the "Apache" corn and the comparative depth of grain and large size of cob.

Crossing of Squashes.

In 1903 six kinds of squashes were grown as a supplemental crop with the sweet corn, as follows: (1) "Hubbard," (2) "Boston Marrow," (3) "Delicious," (4) "Golden Hubbard," (5) "Mammoth Crookneck" and (6) "Long Island White Scallop." Among the winter varieties, crosses were secured only between (1) "Hubbard" upon (2) "Boston Marrow," expressed by the fraction 1-2, the numerator representing the male and the denominator the female parent; and the (3) "Delicious" upon (4) "Golden Hubbard," as expressed by the fraction 3-4.

With the bush or summer varieties, full-sized fruits were obtained with both the "Crookneck" and the "Scallop," or flat type as the mother parent, and the crosses are represented by the fraction 5-6 in one instance and 6-5 in the reciprocal.

A consideration of the differences among the varieties that were crossed is to be found in the report for 1903, pages 479 to 482. The fruits resulting from the cross did not differ from others upon the same vines; in other words, in no instance was there any noticeable effect of the foreign pollen upon the form or other character of the squash.

During the present season seeds from these crossed fruits have been grown, and one of the remarkable features of the bush plants has been their great vigor.

Of the winter crosses, only one fruit was obtained the present season, namely, of the "Delicious" upon "Golden Hubbard," and this was pollinated with the "Hubbard" upon "Boston Marrow," 1-2. The seeds of this fruit, it is presumed, carry the "blood" of the four varieties above named, and its progeny might be expressed by the compound fraction 1-2—3-4.

The fruit in question is of the "Golden Hubbard" type, and, therefore, resembling the female parent more than the male, or "Delicious." It is oval and pointed at both stem and flower end, with a prevailing orange color much mixed with green toward the blossom end.

One other winter squash was added to the list under experimentation, namely, "The Warren," which takes the record number (7), and becomes of special interest, as there is hope that a hybrid may be secured between this and a cross of the bush varieties, which, being upon the latter, is considered in a later paragraph.

The two varieties of summer squashes differ greatly in the form and color of the fruits, those of the "Crookneck" (5) producing long yellow and somewhat bell-shaped fruits, with much variation in the shape of the "neck," some being slightly and others much curved, while a few are thickly beset with wart-like outgrowths, while others are nearly smooth. The "Long Island Scallop" (6) is uniformly white, disk-shaped, and, except for their scalloped sides, the fruits are comparatively smooth.

One of the results of the combination of these two varieties in the first season after the cross was made in the plants, is the remarkable vigor in the plants, in striking contrast with the parent types, grown near by for comparison.

In the cross represented by the fraction 5-6—that is, with the "Crookneck" as the male parent—the fruits combine the shape of the two parents; in place of the long yellow crook neck of the one and the disk-shape of the other, there often results a jug-shaped fruit, with the shallow scallops long, making a fluted surface, narrowing into a straight, short smooth neck.

The upper row of fruits in Plate IV. shows the parent "Crookneck" (5) at the left, and a series of types of the crosses with it as the male at its right, while in the lower row is the "Scallop" (6) at the right end, and the crosses with it as the male to its left. In the upper row it is seen that the "Crookneck" type is strongly adhered to in No. 2, and less so in No. 3. Both of these types carry the orange color of the parent in distinct bands, with irregular borders, between the more or less distinct scallops. No. 4 has a distinct lemon color throughout its whole surface, while Nos. 5 and 6 approach the "Scallop" type, particularly in the color which may be termed a cream-white. There seems to be some correlation between the orange color and the shape of the fruit; that is, the nearer the fruit approaches the shape of the male parent, the nearer it does so in color. There does not seem to be the same association between shape and warts, or warts and color, as these protuberances are produced without apparent order.

In the lower half of the plate, when the "Scallop" is the male, the fruits are arranged with those most like the female parent near it at the right. In this series there is an entire absence of orange or lemon color of the female parent, but the shape of the "Crookneck" is suggested in No. 7. This type and some of the others have a delicate pink white which is solid in No. 7, but limited to bands in No. 8. The fruits, Nos. 9, 10 and 11 are cream white.

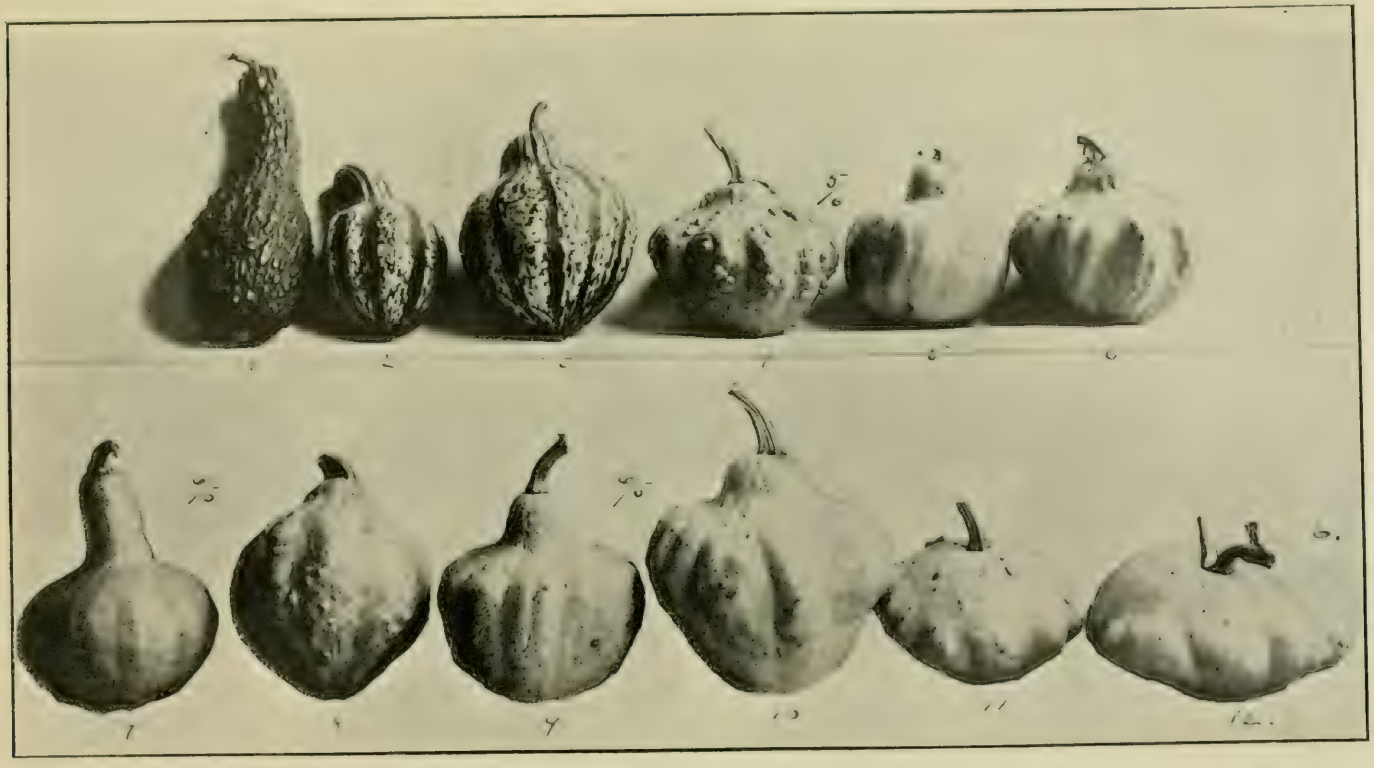


PLATE IV. Crosses between "Crookneck" and "Scallop" Squashes. The upper row begins with the Crookneck parent followed by five forms of the crosses with the Crookneck as male parent. The lower row has the Scallop as male parent at the right with five crosses to its left.

The following additional bush squashes were grown the present season:

No. 8. "Early Bush Squash." This is cream-white scallop squash, with fruits quite deep in cross-section, and more or less ribbed.

No. 9. "Golden Bush." This is a squash of the scallop type, quite flat, of a solid deep orange color, and very smooth on top and bottom.

No. 10. "Mammoth White Scallop" is well named, being quite like No. 9, excepting in color, which is a cream white.

No. 11. "Strickler's Summer" is an orange-colored squash of the "Crookneck" type, but with the neck but little curved. It is well supplied with warts.

No. 12. "Silver Custard." This is a handsome cream-white squash, somewhat ribbed, and flat upon the bottom side and deeply oval above the scalloped rim.

No. 13. "Giant Summer" has a long orange fruit, shaped like an Indian club, with but few warts, arranged somewhat in rows.

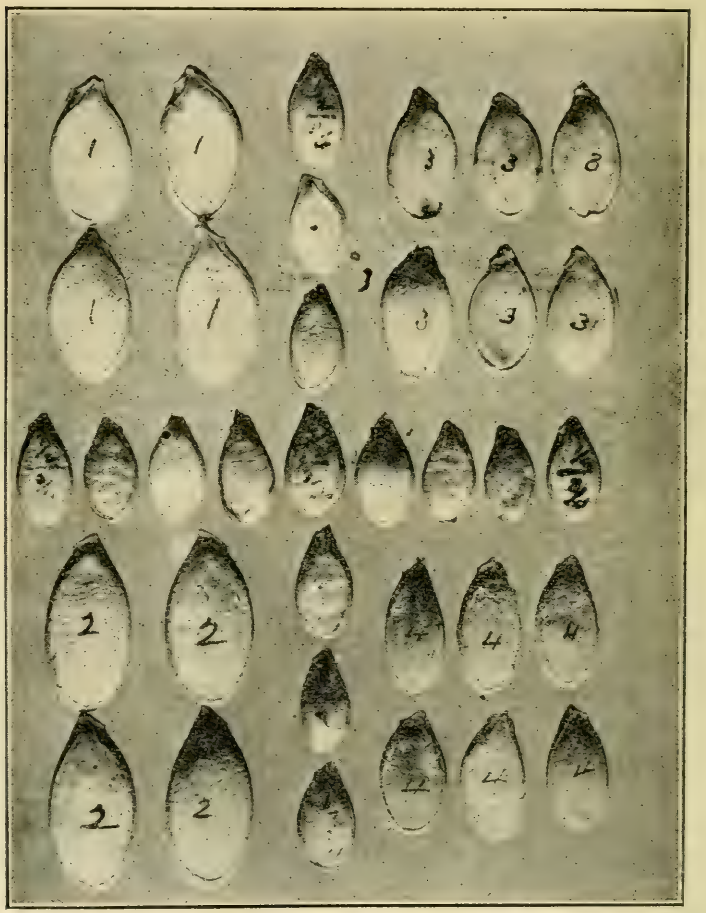
Seeds of Crossed Squashes.

As before stated, a double cross was secured this season between the cross of "Hubbard" (1) upon "Boston Marrow" (2) as the male parent and "Delicious" (3) upon "Golden Hubbard" (4) as the female, a cross represented by the compound fraction 1-2—3-4.

The seeds of the "Hubbard" are large, oval and white, the surface resembling that of a white kid glove. And the same is true of the "Boston Marrow" seeds, excepting that they are more elongated and somewhat thicker. The "Delicious" has a seed quite like the "Hubbard" in color and texture, but very much smaller, while "Golden Hubbard" bears the same relations to the "Boston Marrow."

The double cross of these four varieties has seeds that are perhaps nearer the "Delicious" than any other, but smaller and much more "boat-shaped." Instead of being flat, like all of the parents, the seeds in question are decidedly oval. It is noteworthy that the seeds of the cross do not combine the sizes of the parents, but are a deal smaller than the smallest of their ancestors.

The relative sizes of these five sets of seeds are shown in the accompanying figure, where the seeds of the offspring form a

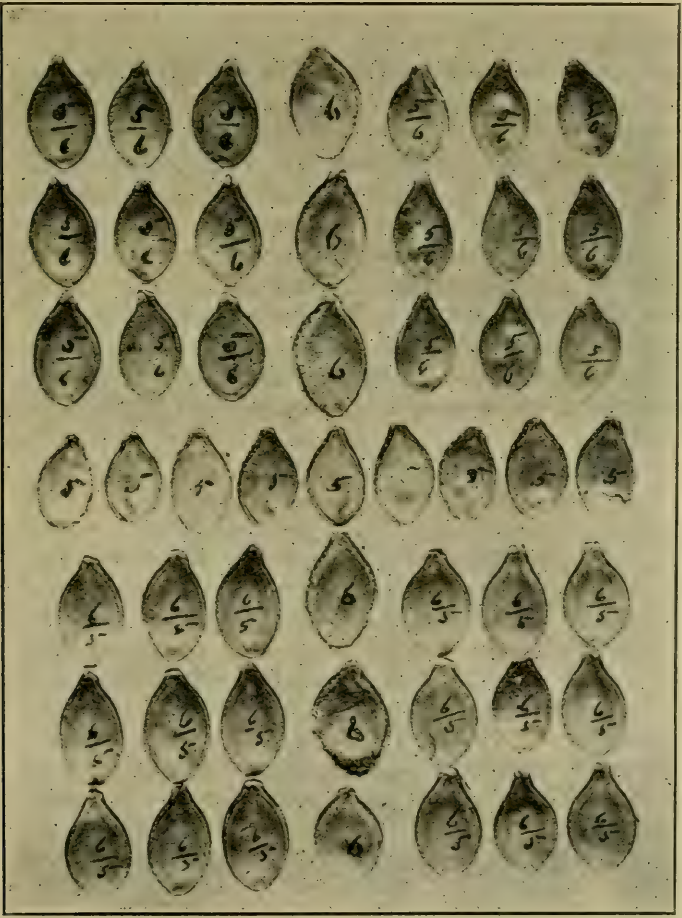


cross and the four parents occupy the corners, all being indicated by their record number.

In the crosses of bush squashes there is a decided difference between the "Crookneck" (5) and the "Scallop" (6), the former being much smaller than the latter. In the crosses there seems to be a variety of sizes, the individual fruit having much influence in this particular. In no instance were seeds of any crossed fruit found as large as the "Scallop" (6) parent, but on the other hand there were many cases where the size fell below those of the "Crookneck" ancestor.

Perhaps the greatest variations was found in the fruits of the cross expressed by the fraction 5-6; that is, where the "Scallop" was the female parent.

The accompanying figure is an attempt to show something of the differences above noted. Running through the center, from right to left, is a row of the "Crookneck" (5) seeds, and vertically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a row of the "Scallop" (6), thus forming a cross. The difference in the size of the seeds of the two parent varieties is thus made evident. In the upper left-hand corner of the "cross" is a set of nine seeds from a fruit resulting from a cross represented by the fraction upon each seed. Seeds from another fruit of the same cross are shown in the upper right-hand corner. The considerable difference between the sizes of these sets of seeds is quickly seen, and also their relative sizes as compared with those of the parents. In the lower half of the figure are two corresponding sets of seeds from fruits of the 6-5 cross. The average size of the seeds of the 6-5 crosses is nearer the "6" than the "5" parent, while the 5-6 crosses are nearer the "5" than the "6." In other words, the male has the greater power to control size, but there are individual exceptions to this possible rule.

Three fruits were obtained upon the 5-6 cross, the flowers of which received pollen only from "Warren" (7), a running winter squash of the turban type, and hope was entertained that a hybrid had been secured between *Cucurbita Pepo* and *C. Maxima.* The fruits grew to fair size, but upon opening them they contained no seeds. The ovules were numerous and perhaps one-half the size of normal seeds, but their contents were watery and embryos entirely absent. In connection with this negative result, it may be of interest to bear in mind that the fruits grew to marketable size, through the stimulus, it may be, of a foreign pollen that was not able to fertilize the ovules. There is some encouragement in the result to make further attempts to secure a hybrid.

Experiments With Eggplants.

The cross between the "New York Improved Spineless" variety of eggplant and the "Early Long Purple," secured in 1900, has been again grown the present season, and the fruits from all the plants are so uniform in form, color and other characteristics that this cross is ready for distribution under the name "Jersey Belle," suggested in the report for last year. This cross has uniformly shown the upright habit of plant of the "Long Purple" combined with the broad leaf of the "New York Improved." There is also the purple color of the young stems and leaf stalks of the former parent and the stoutness of the latter variety. This combination has secured a vigor and productiveness that has been in evidence since 1901, and in interesting contrast with the parent stocks grown for comparison with it.

The fruit, instead of being of the long, slender and often curved form of the "Long Purple," or nearly oval, as in the "New York Improved," is a combination of the two extremes, with a general shape that agrees with that of the "Bartlett" pear. No change in color has developed, as both parents were of the handsome deep purple so popular with the consumers of this vegetable. The fruit of the "New York Improved" are large and oval, and the slices are not well suited for the frying-pan or serving upon the table, while the cross is a decided improvement in this respect. In the "Long Purple" the fruit is too long and slender, but has the seeds confined to the lower half, and the "Jersey Belle," holding to this latter characteristic, often has two-thirds of its flesh free from seeds. The cross gives three or more slices free from seeds, where the "New York Improved" furnishes but one.

In 1901 it was particularly noted that the cross was remarkable for earliness, for as the record runs its plants began to yield marketable fruits on July 20th, while it was August 8th before they could be gathered from the "New York Improved" and were rare upon the "Long Purple" until September 10th.

In 1902 it was observed that "toward the close of the season the parent sorts ceased blooming, while the cross blossomed freely up to the time of frosts, and then the plants contained many young fruits. It was noted that the general shape (pear) was adhered to, and not over 10 per cent. of the plants produced fruits of the 'New York Improved type."

In 1903 the record runs: "Two plots contained about two hundred plants, representing the third generation of the above cross. Some of the fruits resembled in form and size those of the parent types, but the majority were noticeably different, and more or less bell-shaped." Seeds were, of course, saved only from plants that produced uniformly fine fruits of the pear-shape above mentioned.

Seed of the "Jersey Belle" will be ready for free distribution to the truckers and others of the State in time for next season's crop.

Other Varieties Tested.

Early Long Purple.
Excelsior Tree.
Fordhook's Imp. Spineless.
Black Pekin.
Black Beauty.
Florida High Bush.
New Excelsior Tree.
Striped.
Scarlet Chinese.

The last named has a flat and scalloped fruit, with a scarlet color that makes this fruit easily mistaken for a tomato. It shrivels when mature, like a pepper. Attempted crosses of it with other sorts it is hoped have been successful.

Other Crosses of Eggplants.

One of the crosses made in 1902 has been grown for its second generation the present season, namely, the "Long White" upon the "New York Improved." In the report for last year it was stated that this cross varied " much in color and shape, as the parents were quite unlike in these respects. The curved form of the male parent was present in many of the crosses, while its white exterior blended with the purple of the mother plant in producing a variegated surface, some fruits being spotted white and purple, others somewhat striped, and others of nearly a solid shade of green."

By selecting the seeds from the plants producing oblong purple fruits a reasonably uniform lot of fruits has been obtained the present season. Plate V. shows some of the variations in form, those in the upper row being from one lot of seed, and those in the lower row being from another. Some of them are not fully mature, as indicated by relative size of calyx. The color is fairly uniform, and is of a pale purple or pink, with some excepting, which are nearly green. One plant produced white fruits, thus showing the "blood" of the male parent in the cross two years before.

This cross between two strikingly different varieties brings much vigor to the offspring, and the indications are that in a few years, by careful selection, a new variety may be established, that will have an oval or oblong shape quite acceptable to the growers of this vegetable. The greater difficulty will lie in getting a color that is suited to the taste of the consumer. In case of the eggplant, the color of the skin plays no part in the appearance of the vegatable when it comes to the table, and it would seem that a light purple, or even pink, ought to be acceptable as the purple that custom has come to expect in the eggplant.

EXPERIMENTS WITH TOMATOES.

The Station Yellow Tomato.

The cross resulting from a combination of "Golden Sunrise" upon "Dwarf Champion" in 1899 has proved so well established

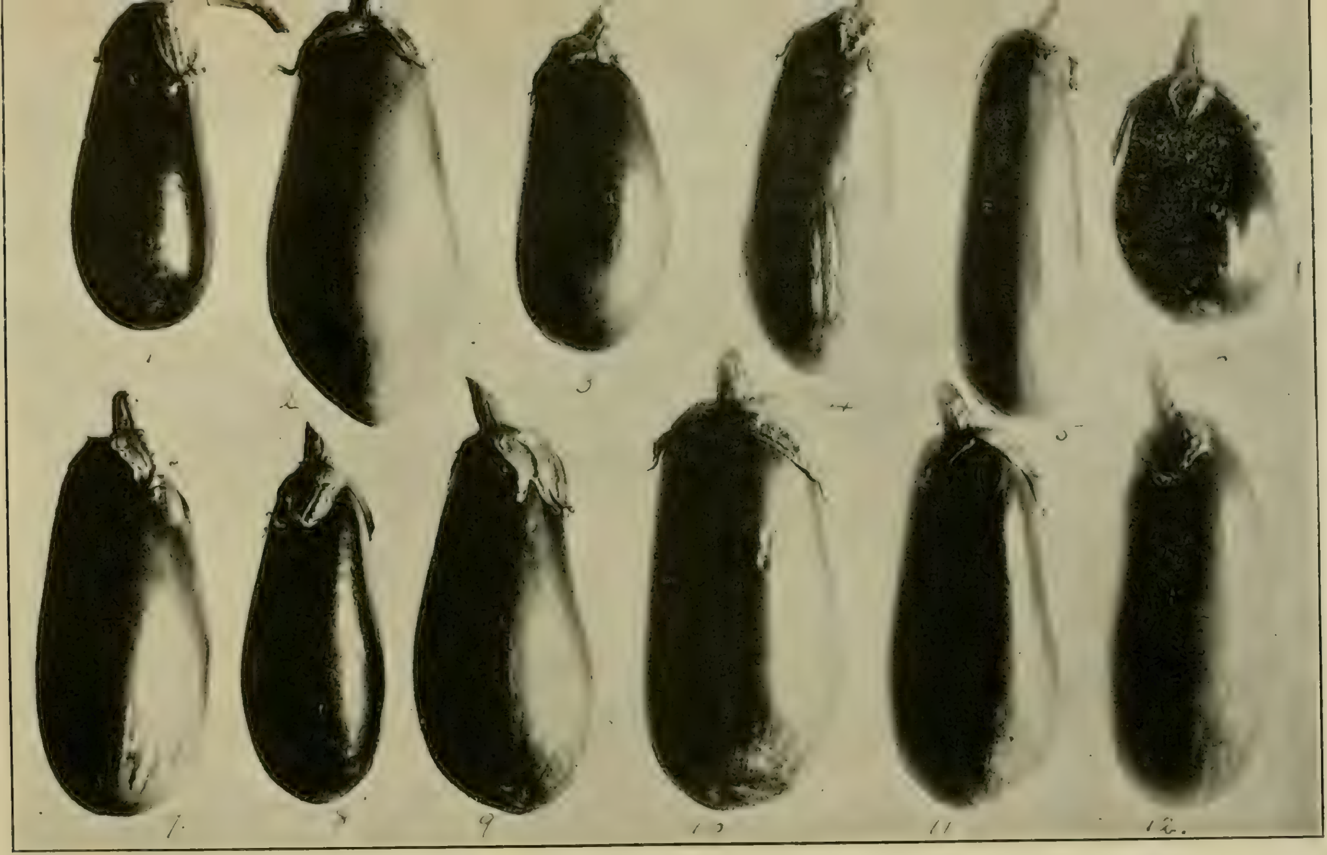

PLATE V. Various samples in the crosses between "New York Improved Spineless" Eggplant and the "Long White" Variety. The size of Fruit is much increased and the color is sometimes pink instead of purple.

by the many trials during last year and the present season that it warrants the above name, given to it in the report for 1903, where it is figured with its two parents in a full-page plate. The "Station Yellow" gets its fine color, nearly that of a ripe lemon, from the male parent ("Golden Sunrise"), and the upright or dwarfed habit of vine from the female, or "Champion" ancestor. When the fruits are fully mature, they usually have some of the red of the mother parent, showing as pink streaks radiating from the blossom end.

In extending the description of the new variety, the following is taken from the last report.

"To those who know the bushy habit of the 'Dwarf Champion,' with its thick-set leaves upon a plant of under size, and the nearly opposite characteristics of the 'Golden Sunrise,' will expect what is obtained in the cross, namely, a larger plant than that of the female parent, and one with something of the great vigor of the male parent. To say that it is a yellow "Dwarf Champion" is not telling the whole truth, because the differences are more than color of fruit. The plants and the fruit are both somewhat larger than the 'Dwarf Champion,' and the foliage is not so much infolded or 'curled,' or 'potato-like,' as some are pleased to call it."

During the present season, this variety has shown a thickness of wall of the fruit that is a pleasing response to selection in this respect. It seems to be a general fact that firmness of fruit, thus rendering them good for marketing and slow to decay, is associated with a thick wall. This also adds to the percentage of edible flesh, as only the filmy skin is removed for the table, and correspondingly diminishes the less desirable pulp.

It may be said, in addition, that there is only one other dwarf yellow known to the writer, and after growing it the present season, there is no reason for confusing the two, because differing in both plant and fruit. In addition, the "Station Yellow" has a different pedigree, that is within the reach of all who may wish to know it.

Seeds of this variety have been saved from the best fruits of the best plants, and they are ready for free distribution to the crop-growers of the State.

The Magnus-Ponderosa Crosses.

During the last winter reciprocal crosses were obtained in the greenhouse between the "Magnus" and "Ponderosa" varieties.

These crosses fruited this season in the field, and proved very satisfactory. The "Magnus" is a fine "pink" fruited "potato-leaved" standard variety that is popular for its good qualities of fruit and plant, while the "Ponderosa" is still more widely known as a remarkably productive large-fruited pink sort. The latter variety has some objectionable qualities, among which are the irregular shape of the fruit and the unevenness with which it ripens. The fruits, while large and "meaty," waste badly in the preparation for the table, a single fruit often not yielding more than two whole slices. The general shape of the "Ponderosa" fruit is well shown in the middle of the left row in Plate VI. The "Magnus," shown in the corresponding row to the right, has a comparatively smooth, deep fruit, somewhat inclined to be angled, as indicated in the middle specimen. The foliage of the two varieties is quite distinct, the "Ponderosa" being of the ordinary type, while the "Magnus," as above stated, is "potato-leaved;" that is, the parts are thick, wrinkled, and of that general character of shape, texture and color which has suggested the name applied to this type of tomato foliage. These differences cannot be well shown by a fragment in a picture, but something of them are to be seen.

The crosses are shown in the two middle rows, theone upon the right being the "Magnus" pollinated with the "Ponderosa," and the remaining row the reciprocal. The former is near the mother type in foliage and character of the interior of the fruit. This latter fact is shown by comparing the sections of the fruit seen at the bottom of the respective rows. If the "Magnus" has a fault in its fruit, it is in the large cells, giving a preponderance of seed cavity. The opposite of this is true with the "Ponderosa," which is remarkable for the large number of small seed cells and a high percentage of flesh. The cross upon the "Magnus" has secured something of this excellent quality, but at the same time somewhat of roughness and grooves at the stem end of the fruit, although the latter is not enough to be serious.

The reciprocal of the above, namely, with the "Magnus" pollen upon the "Ponderosa," has given a plant more like the female than male parent, while the fruits are close to those of the above-described cross. There is somewhat more gain in content of flesh. In other words, the solid core is broken by seed cavities, and the fruit may be expected to be oblong to some extent, as in the "Ponderosa." In short, thus far the crosses are better than either parent. The fruit is a fine "pink," as

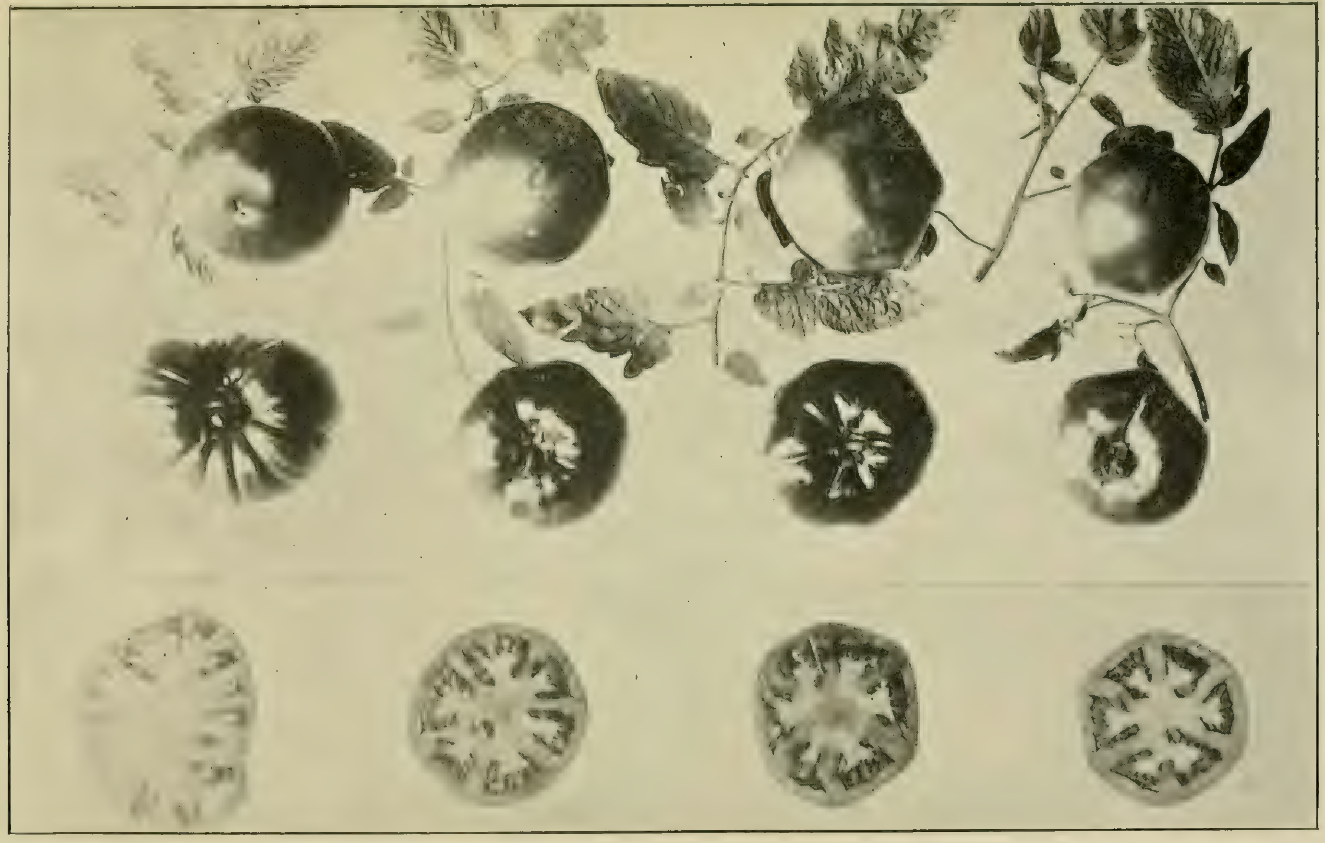

PLATE VI. Crosses of "Ponderosa" and "Magnus" (Magnerosa) tomatoes are shown in the center while the parents are upon the left ("Ponderosa") and right ("Magnus") of them.

might be expected, as the "Magnus" and "Ponderosa" agree in this character.

"Seedless" Tomatoes.

Several plants of the old "No. 177" stock have been grown the present season. The "Giant," as it is called, and the beginning of the "Seedless" stock, came originally from a cross of "Golden Sunrise" upon "Dwarf Champion" in 1899. It was so large that it stood above all surrounding plants, and made a spread of about ten feet. It was remarkable in having but few (27) fruits, all about an inch in diameter, and with seeds ranging from none to six for each tomato. Plants in successive generations have been grown from these seeds each year since 1899. The following is taken from the report for last year:

"Seeds of third-generation fruits of this number were sown in the greenhouse the past winter, and some of the seedlings were remarkable, owing to their having three, and, in one instance, four cotyledons. From these seedlings a few small and almost seedless fruits were obtained, and from these came, for a late setting, the plants in rows 5 to 10, in plot III Several of these have produced more and larger fruits than their parent plants, and bore a very limited number of seeds. Specimens of these fruits are shown in Plate VI. [1903]. The number of seeds in each fruit ranged from five to fifty, while those of ordinary tomatoes is among the hundreds."

The plants the present season are in many ways a duplicate of the last. The fruits are two inches in diameter, and nearly seedless, as tomatoes go, sufficiently so for all practical purposes of propagation.

It is interesting to note that all of the many attempts to cross the "Giant" upon other varieties failed, and in several instances when pollen of "Potato-Leaf" (104) and "Yellow Prince" (148) was used upon its flowers there resulted marketable sized fruits, but without any seeds—cases of seedlessness far beyond the breeder's desire.

Further Experiments With Tomatoes.

During the present season, a large portion of the experiment area has been in tomatoes. Seeds were obtained from a long list of dealers and others, representing a wide range of country, in order that a great variety of conditions of seed production might be included in the experiment. A study of these varieties has been made, as they grew in the same plots, and some of the results are given in the table below. A large amount of crossing was secured between a wide range of kinds. The table shows the experiment number for each sort, and the name and source of the seed, followed by the number of marketable fruits at each of the seven pickings. To this is added the number of cracked, rotten and small and green fruits. The average fruit per plant, together with the average size, gives something as to the yield of each sort, while the total of marketable fruits (near the middle of the columns of figures) indicates the real product. The season when these latter fruits were gathered is shown by the figures under each date of picking. Thus it is seen that "Bermuda" (11) gave the largest picking on August 8th, while the "Duke of York" (32) on August 29th. A glance, for example, at the figures for No. 3, "Advance," and No. 4, "Arcadia," give much information as to the profitableness of those two varieties as grown under the conditions that obtained at the Station gardens for 1904.

Table of Yield of the Trial Tomatoes.

No.	NAME AND SOURCE.	August 1.	August 8.	August 15.	August 23.	August 29.	September 7.	September 19.	Total.	Cracked.	Decayed.	Small.	Green.	Total.	Per Plant.	Size.	Season.	Popularity.
1	Acme, Btl.	3	1	5	6	1	2	0	19	0	8	33	0	60	10	s.	m. e.	161
2	Acme, Liv.	0	5	10	10	5	4	0	34	3	10	80	0	127	21	s.	m. e.	....
3	Advance, Hlm.	0	7	0	2	0	0	0	9	0	16	126	0	151	30	v.s.	m. e.	6
4	Arcadia, Jer.	16	24	34	14	2	2	0	92	11	30	50	0	183	31	m.	e.	....
5	Arcadia, Jer.	5	9	21	5	1	4	0	45	9	43	22	0	119	19	m.	e.	....
6	Atlantic Prize, Btl.	5	5	15	19	17	1	2	64	0	22	45	0	131	22	m.	e.	132
7	Atlantic Prize, Thr.	3	14	16	4	3	1	0	41	16	24	54	0	135	22	m.	e.	....
8	Beauty, Btl.	5	7	25	25	3	2	2	69	0	23	46	5	143	29	m.	m.	187
9	Beauty, Liv.	1	5	27	26	11	0	0	70	0	34	81	0	185	31	m.	m.	....
10	Belmont, Brk.	3	9	18	29	14	0	2	78	3	40	64	0	185	31	m.	m. l.	4
11	Bermuda, Lan.	11	22	12	4	1	0	1	51	6	39	28	0	124	21	m.	e.	1
12	Best of All, Drr	6	4	38	17	21	2	1	89	1	39	34	0	163	27	m.	m. e.	11
13	Brandywine, J. & S.	5	2	20	17	16	3	0	63	1	16	49	0	129	22	m.	m. l.	5
14	Bright and Early, Vk.	0	7	2	3	1	0	0	13	2	31	333	0	379	63	v.s.	m. e.	6
15	Brinton's Best, J.&S.	4	8	21	27	22	5	0	87	2	21	52	4	166	28	m.	m.	9
16	Brinton's Best, Rolfs.	1	16	16	13	17	5	0	78	2	17	91	0	188	31	m.	m. e.	....
17	Buckeye State, Fer.	0	0	12	14	14	8	4	52	0	4	18	4	98	16	l.	l.	76
18	Buckeye State, Hlm	0	3	7	21	19	6	0	56	0	15	24	4	93	16	l.	l.	....
19	Canada Victor, Ggy.	10	22	12	0	13	0	0	57	0	37	106	0	200	40	m.	e.	21
20	Cardinal, Liv.	0	5	12	8	5	2	0	32	2	22	74	3	186	31	m.	m.	13
21	Climbing, Chl.	0	9	6	14	17	7	2	55	2	12	19	0	88	15	m.	m. l.	2
22	Combination, Bur.	0	4	4	8	5	0	0	21	2	12	72	0	107	21	s.	m.	12
23	Combination, Hlm.	0	6	2	4	4	4	0	20	1	4	49	0	74	12	s.	m.	....
24	Conqueror, Liv.	0	6	2	2	0	0	0	10	1	55	14	0	80	13	m.	m.	12
25	Cream City, Cur.	1	2	3	9	1	2	0	18	0	63	18	3	102	17	m.	m.	2
26	Crimson Cushion, Hen.	0	1	14	11	6	3	1	36	1	18	12	0	67	11	l.	m.	52
27	Crimson Whirlwind, Sal	2	4	14	18	11	3	1	53	1	15	26	2	97	16	m.	m.	1
28	Cumberland, J. & S.	1	4	11	10	8	0	0	34	0	26	155	0	215	36	m.	m. e.	5
29	Dominion Day, Bru.	3	24	30	8	1	2	2	70	5	29	37	0	141	24	m.	m. e.	2
30	Democrat, Thr.	0	7	19	14	13	0	0	53	0	22	83	0	158	26	m.	m.	1
31	Diadem, Chl.	0	3	20	13	8	0	0	44	1	27	95	0	167	28	m.	m.	2
32	Duke of York, Rolfs.	0	0	13	23	28	14	9	87	1	37	57	10	192	32	l.	l.	1
33	Earliana, Bru.	4	3	50	4	0	0	0	61	9	28	40	0	138	23	m.	e.	13
34	Earliana, Fer.	4	12	39	5	0	0	0	60	7	32	46	0	145	24	m.	e.	....
35	Earliana, Ggy.	2	11	40	5	0	0	0	58	11	36	20	0	125	21	m.	e.	....
36	Earliana, Hulsart.	1	15	25	5	0	0	0	46	9	29	51	0	135	23	m.	e.	....
37	Earliana, Rolfs.	1	6	32	9	5	0	0	53	5	26	79	0	163	27	m.	m. e.	....
38	Earliest of All, Drr.	4	13	34	0	0	0	0	51	1	36	169	0	257	43	m.	e.	12
39	Earliest, Lan.	1	10	25	11	8	2	0	57	8	27	73	1	160	27	m.	m. e.	1
40	Earliest, Thr.	1	20	20	6	3	0	0	50	0	19	166	9	235	39	m.	e.	1
41	Early Bird, J.&S	1	4	5	6	3	0	0	19	4	24	145	1	193	39	s.	m. e.	4
42	Early Ruby, Liv.	2	21	11	5	0	1	0	40	9	49	31	0	129	22	m.	e.	54
43	Enormous, Ggy.	0	4	13	16	7	8	10	58	1	17	21	13	110	17	l.	l.	30
44	Enormous, Hrs.	0	21	10	6	14	5	6	62	0	11	8	7	88	15	l	l.	....
45	Essex Hybrid, Fer.	0	4	6	1	1	0	0	12	1	47	22	0	82	14	m.	m. e.	29
46	Everkarge, Lan.	0	5	5	5	1	0	0	16	2	36	5	3	62	12	m.	m. e.	9
47	Excelsior, Iow.	0	7	15	22	6	3	1	54	2	45	32	0	133	21	m.	m. l.	....
48	Favorite (Liv's), Btl	0	7	22	17	9	4	2	61	2	21	66	0	150	26	m.	m.	162
49	Favorite (Truckers') Bur	0	3	20	34	16	3	3	79	0	30	48	6	163	33	m.	m. l.	22
50	Favorite (Liv's.), Liv.	0	11	24	30	10	2	0	77	0	13	57	2	149	30	m.	m.	....
51	First of All, May.	1	18	13	3	2	0	0	37	2	51	79	0	169	28	m.	e.	2
52	Fordhook First, Jer.	3	6	19	27	0	1	0	56	0	25	48	0	129	26	m.	m. e.	41
53	Fortune, J.&S.	1	3	17	26	20	8	3	78	1	22	77	8	186	31	m.	m. l.	2
54	Freedom, Hen.	0	3	10	12	8	2	0	35	0	24	158	0	217	33	s.	m.	29
55	Frogmore, Drr.	0	0	5	8	2	0	0	15	2	32	136	0	185	31	s.	m.	3
56	Giant, Evr.	0	5	8	5	4	5	1	28	0	21	15	12	76	13	v. l.	m. l.	3
57	Giant Climbing, Chl.	0	0	5	8	2	5	5	25	1	12	5	14	57	10	v. l.	l.	2
58	Grandus, Liv.	0	2	8	10	14	5	0	39	0	40	75	0	154	26	m.	m. l.	0
59	Honor Bright, Btl.	0	2	5	19	28	13	0	67	0	29	47	2	145	29	m.	m. l.	81
60	Honor Bright, Brk.	0	4	8	18	26	17	0	73	0	9	63	2	147	26	m.	m. l.	....
61	Honor Bright, Liv.	0	0	12	28	18	10	6	74	0	14	56	5	149	26	m.	l.	....
62	Ignotum, Hlm.	5	12	16	24	13	0	2	72	1	19	45	0	137	23	m.	m. e.	70
63	Imperial, Drr.	0	10	14	13	21	2	0	60	1	34	38	0	133	22	m.	m.	69
64	King Humbert, Drr.	0	0	0	0	0	0	0	0	0	56	516	0	572	114	v.s.	m.	2
65	King of the Earlies, Rolfs.	2	10	40	2	1	5	0	60	6	39	31	0	136	23	m.	m. e.	3
66	Jewell, Bur.	1	9	26	21	18	4	1	80	4	22	50	6	162	27	m.	m.	2

Table of Yield of the Trial Tomatoes.

No. NAME AND SOURCE.	August 1.	August 8.	August 15.	August 23.	August 29.	September 7.	September 19.	Total.	Cracked.	Decayed.	Small.	Green.	Total.	Per Plant.	Size.	Season.	Popularity
67 LaCrosse Seedling, (Sal)	1	0	2	0	0	0	0	3	3	36	12	0	54	17	m.	m. e.	1
68 Leader, Vk.	4	7	5	0	2	2	0	20	0	94	26	0	140	28	m.	m. e.	2
69 Liberty Bell, J. & S.	4	7	23	15	8	4	1	62	0	24	94	0	180	30	m.	m.	7
70 Longkeeper, Evr.	0	7	10	21	6	2	0	46	0	31	64	0	141	24	m.	m.	26
71 Lorillard, Elt.	0	3	9	20	16	4	0	52	4	19	53	0	128	26	m.	m.	34
72 Magnificent, Mau.	0	5	13	27	22	7	1	75	0	29	31	0	135	23	m.	m. l	0
73 Magnus, Drr.	0	0	13	28	12	7	1	61	0	25	56	0	142	24	m.	m. l.	71
74 Magnus, Evr.	0	6	18	23	11	6	0	64	1	18	34	0	117	19	m.	m.	....
75 Magnus, Ggy.	0	1	24	20	7	0	0	52	2	25	58	0	137	23	m.	m.	....
76 Magnus, Liv.	0	6	32	25	11	0	3	77	2	36	63	4	182	31	m.	m.	....
77 Marvel, Drr.	1	4	12	11	9	0	0	37	0	19	68	0	124	21	m.	m. e.	1
78 Marvel, Drr.	5	7	32	17	9	4	2	76	1	29	32	0	138	23	m.	m. e.	....
79 Matchless, Btl.	3	3	10	30	12	3	4	65	0	22	65	0	152	25	m.	m.	86
80 Matchless, Fmr.	2	8	30	16	14	0	0	70	3	29	62	4	168	28	m.	m. e.	....
81 Matchless, Rolfs.	0	0	18	37	23	5	3	86	0	12	52	0	150	25	m.	m. l.	....
82 Matchless, Thr.	0	3	20	20	18	2	0	63	2	31	46	5	147	24	m.	m.	....
83 Mayflower, Drr.	2	5	24	17	15	2	1	66	4	15	95	0	180	45	m.	m.	15
84 Melrose, Hlm.	1	10	30	20	8	8	5	82	4	34	59	0	179	30	m.	m.	1
85 Michigan, Fer.	5	9	31	36	12	3	2	98	0	28	86	0	212	35	m.	m. e.	22
86 Michigan, Hlm.	2	8	23	26	7	4	0	70	4	21	84	0	179	30	m.	m. e.	....
87 Minnesota, Ggy.	0	4	14	2	3	0	0	23	1	21	173	0	218	36	s.	m. e.	23
88 Mississippi, Chl.	2	8	18	21	3	0	2	54	1	14	65	0	134	22	m.	m. e.	1
89 Mikado, Evr.	0	7	1	1	0	2	0	11	0	23	11	0	45	8	m.	m. e.	103
90 Mikado, May	0	4	10	3	10	2	2	31	0	38	13	0	82	14	m.	m.	....
91 Moneymaker, Lan.	1	22	34	3	0	0	0	60	0	33	27	8	128	21	m.	e.	5
92 Multicolor, Liv.	0	8	2	9	5	7	2	33	0	29	48	6	116	19	m.	m. l.	1
93 New Jersey, Thr.	1	5	16	28	19	4	3	76	0	11	30	0	117	19	m.	m.	2
94 Noltes' Earliest, Fer.	12	31	28	0	0	0	0	71	8	57	37	0	173	29	m.	e.	1
95 Noltes' Earliest, Ggy.	13	34	26	2	2	2	0	79	6	59	32	0	176	30	m.	e.	....
96 Novelty, Thr.	1	3	8	25	10	9	3	59	2	28	29	8	126	21	m.	m. l.	0
97 Optimus, Fer.	4	6	15	11	6	3	3	48	2	23	108	3	184	30	m.	m.	38
98 Paragon, Liv.	0	5	30	25	6	6	3	75	0	20	38	6	139	28	m.	m.	80
99 Perfection, Btl.	3	6	20	19	5	0	2	55	2	21	71	0	149	25	m.	m.	173
100 Perfection, Liv.	8	12	23	26	4	0	0	73	0	23	55	0	151	26	m.	m. e.	....
101 Picture Rock, Chl.	3	4	31	16	4	0	0	58	0	23	49	0	130	22	m.	m. e.	1
102 "Pink," Hulsart	5	2	25	12	2	3	0	49	2	25	44	0	120	24	m.	m. e.	....
103 Ponderosa, Hen.	0	2	5	9	5	2	1	24	0	54	15	0	93	16	v.l.	m.	154
104 Potato Leaf, Liv.	4	3	25	10	5	1	0	48	1	25	62	0	136	23	m.	m. e.	7
105 Potomac, Hrs.	3	7	29	10	2	0	0	51	0	37	90	0	178	29	m.	m. e.	2
106 Prest. Cleveland, Fqr.	0	10	18	11	10	0	2	51	0	31	86	0	168	28	m.	m. e.	2
107 Prizetaker, Hlm.	2	0	8	8	3	3	0	24	3	23	32	0	82	16	s.	m. e.	4
108 Prizetaker, Hlm.	6	13	15	11	9	3	1	58	3	35	95	0	191	32	s.	m. e.	....
109 Princess, Liv.	1	6	11	11	4	0	0	33	0	44	127	0	204	34	s.	m. e.	2
110 Quicksure, Iow.	5	6	21	15	5	2	0	54	0	15	156	0	225	38	s.	m. e.	5
111 Richmond, Lan.	9	25	0	1	0	0	0	35	3	43	13	0	94	19	m.	e.	3
112 Rosalind, Thr.	0	4	5	4	2	0	0	15	1	45	11	6	78	13	m.	m.	3
113 Rose Peach, Liv.	0	5	4	3	2	0	0	14	0	51	58	0	123	21	s.	m. e.	1
114 Royal Colors, Liv.	1	2	0	8	3	0	0	14	0	22	60	0	96	19	s.	m.	1
115 Royal Red, Btl.	2	3	21	29	9	3	0	67	0	21	24	4	116	20	m.	m.	76
116 Royal Red, Liv.	3	3	20	20	13	1	3	63	0	21	29	7	120	24	m.	m.	....
117 Santa Rosa, J. & S.	2	4	17	23	6	3	0	55	0	30	20	0	105	18	l.	m. e.	0
118 Shippers' Choice, Ham.	1	5	12	20	13	3	0	54	0	15	30	0	99	20	m.	m.	1
119 South Jersey, Liv.	20	56	13	0	0	0	0	89	3	40	62	0	194	32	m.	e.	0
120 Stirling Castle, Elt.	0	0	3	3	1	1	0	7	0	19	239	2	267	44	v.s.	m.	1
121 Stone, Btl.	4	11	19	24	12	3	2	75	0	20	75	0	170	28	m.	m.	186
122 Stone, Hulsart.	2	5	13	23	15	0	1	59	0	26	36	0	121	20	m.	m.	....
123 Stone, Liv.	0	9	19	30	14	8	1	81	0	24	27	2	134	22	m.	m.	....
124 Stone, Rolfs.	3	6	20	0	11	3	3	46	0	16	39	4	105	18	m.	m.	....
125 Success, Bur.	0	7	13	29	25	4	2	80	0	21	44	0	145	24	m.	m. l.	12
126 Success, Mau.	2	7	12	19	15	5	0	60	1	17	45	0	123	20	m.	m.	....
127 Success, May.	3	2	13	12	16	5	0	51	0	22	56	8	137	23	m.	m.	....
128 Sut's Best of All, Thr.	6	7	30	7	11	1	1	63	2	27	37	0	129	22	m.	m. e.	....
129 Table Queen, May.	0	5	14	16	3	0	0	38	0	20	10	0	68	11	m.	m. e.	15
130 Terra Cotta, Thr.	2	8	29	13	0	0	0	52	0	26	62	0	140	23	m.	m. e.	2
131 Tree, Kuttawa, Evr.	3	6	5	4	2	0	0	20	0	16	74	0	110	18	m.	m. e.	2
132 Tree, Ham.	1	6	21	9	5	0	0	44	0	19	13	8	84	14	l.	m.	23

Table of Yield of the Trial Tomatoes.

No. NAME AND SOURCE.	August 1.	August 8.	August 15.	August 23.	August 29.	September 7.	September 19.	Total.	Cracked.	Decayed.	Small.	Green.	Total.	Per Plant.	Size.	Season.	Popularity.
133 Tree, Giant, Fmr.	0	4	5	2	0	0	0	11	0	18	23	0	52	10	m.	m. e.	2
134 Tree, Giant, May	0	0	8	10	7	0	1	26	0	4	7	10	47	9	m.	m. l.	....
135 Tree, Giant, Sal.	5	8	19	22	4	0	0	58	1	35	52	0	146	24	m.	m. e.	....
136 Trophy, Drr.	1	4	20	21	10	0	0	56	1	10	23	0	90	15	m.	m. e.	135
137 T.T.T., Lan.	1	3	38	22	12	2	0	78	1	33	47	0	159	26	m.	m. e.	7
138 T.T.T., Rolfs	0	9	12	32	8	6	0	67	2	17	49	0	135	22	m.	m.	....
139 Volunteer, Liv.	0	11	13	22	2	0	0	48	0	26	42	0	116	19	m.	m. e.	29
140 Waldorf, Thr.	3	3	24	11	9	0	0	50	2	16	98	0	166	33	m.	m. e.	4
141 Wonder, Elt.	2	0	3	6	1	2	0	14	0	20	134	0	168	34	v.s.	m.	0
142 $5,000,000, Sal.	1	13	15	15	8	4	0	56	0	27	74	0	157	26	m.	m.	0
143 1903, Thr.	0	4	4	10	9	1	0	28	0	31	47	0	106	18	m.	m.	0
144 Golden Queen, Btl.	0	0	15	17	9	3	3	47	0	39	113	4	203	34	m.	m.	108
145 Golden Queen, Liv.	1	4	18	22	12	2	0	59	3	24	64	0	150	25	m.	m.	....
146 Golden Sunrise, Exp.	0	2	14	7	8	3	0	34	0	9	40	0	83	17	m.	m.	2
147 Lemon Blush, Thr.	6	0	13	26	4	0	0	49	1	26	64	0	140	23	m.	m.	8
148 Yellow Prince, Liv.	0	1	7	12	9	0	3	32	1	5	67	0	105	26	m.	m.	7
149 Aristocrat, Fmr.	2	3	24	9	3	2	0	43	1	22	70	0	136	23	s.	m. e.	67
150 Aristocrat, Hlm.	0	4	11	8	6	2	0	31	0	10	54	0	95	19	s.	m.	....
151 Aristocrat, Liv.	0	0	14	3	2	0	0	21	0	5	52	0	78	19	s.	m.	....
152 Aristocrat, Vau.	1	4	16	15	3	6	0	45	2	9	79	0	135	22	s.	m. e.	....
153 Champion, Btl.	3	2	15	11	5	5	0	41	0	16	53	0	110	17	s.	m. e.	182
154 Champion, Brk.	0	4	5	4	4	0	0	17	0	9	39	0	65	11	s.	m. e.	....
155 Champion, Hen.	4	6	3	1	0	0	0	14	1	7	31	0	53	9	s.	e.	....
156 Champion Scarlet, Brk.	1	6	15	12	4	0	0	38	2	22	104	0	166	33	m.	m. e.	5
157 Champion Scarlet, Vau.	0	10	18	3	3	0	0	34	0	30	54	0	118	20	m.	m. e.	....
158 Dandy Dwarf, Liv.	0	2	8	4	0	0	0	14	0	19	74	0	107	18	s.	m. e.	1
159 Extra Ey. Tree May.	3	13	29	13	6	1	0	64	0	10	79	0	153	26	m.	m. e.	5
160 Fordhook Fancy, Thr.	6	3	20	7	6	0	0	42	0	21	62	0	125	21	m.	m. e.	16
161 Kansas Standard, Btl.	0	4	15	12	9	0	0	40	0	18	52	0	110	18	m.	m.	3
162 Kansas Standard, Bur.	0	6	12	15	14	0	0	47	0	12	71	0	130	22	m.	m.	....
163 Model, Vau.	1	4	12	12	1	0	0	30	0	12	37	0	79	13	m.	m. e.	0
164 Purple Dwarf, Liv.	0	5	6	15	6	3	0	35	0	11	19	0	65	51	m.	m.	0
165 Quarter Century, Bur.	0	4	27	11	7	0	0	49	2	24	74	0	149	26	m.	m. e.	11
166 Quarter Century, Thr.	0	8	24	20	12	1	0	65	0	20	47	0	132	22	m.	m. e.	....
167 Station Upright, Chl.	3	4	12	13	8	1	0	41	0	14	69	0	124	21	m.	m. e.	3
168 Station Upright, Thr.	2	0	19	14	3	0	0	38	0	16	49	0	103	26	m.	m. e.	....
169 Stone Dwarf, Hulsart	1	0	12	19	20	17	3	72	0	12	54	0	138	23	l.	m. l.	0
170 Stone Dwarf, Liv.	4	6	15	20	22	16	0	83	1	14	39	0	137	23	l.	m.	....
171 Stone Dwarf, Thr.	2	4	16	20	15	4	0	61	0	17	56	0	134	22	l.	m.	....

The Fruting Season of Tomatoes.

By regarding the first two pickings with dates of August 1s and 8th respectively, it is seen that the following are the twenty varieties yielding fifteen or more marketable fruits per row of six plants.

Name.	No. of Fruits.	Name.	No. of Fruits.
South Jersey (119)	76	Earliest, Thor. (40)	21
Nolte's Earliest, (95)	47	Perfection, (100)	20
Nolte's Earliest, (94)	43	First of All, (51)	19
Arcadia, (4)	40	Prizetaker, (108)	19
Richmond, (111)	34	Atlantic Prize, (7)	17
Bermuda, (11)	33	Earliest of All, (38)	17
Canada Victor, (19)	32	Ignotum, (62)	17
Dominion Day, (29)	27	Earliana, (34)	16
Early Ruby, (42)	23	Extra E. Tree (159)	16
Money Maker, (91)	23	Stone, (121)	15

The leader (119) of the list it will be noted by glancing at the table, ceased yielding fruits after the third picking and the same was nearly true of the two sets of "Nolte's Earliest," "Richmond," "Early Ruby," "Earliest of All," and "Earliana." Arcadia fruited through a longer period as did "Bermuda," "Canada Victor," "Dominion Day," and "Perfection." "Stone" fruits all through the season and "Ignotum" and "Prizetaker" have a prolonged period and rank as "medium" in their season.

The Late Varieties.

By regarding the last two pickings, September 7th and 19th, it is seen that the following twelve varieties have over ten fruits:

Name.	Total Yield.	Final Pickings.
Duke of York (32)	87	23
Stone Dwf. (169-	87	20
Enormous (43)	58	18
Honor Bright (60)	73	17
Honor Bright (61)	74	16
Stone Dwf. (170)	83	16
Honor Bright (59)	67	13
Melrose (84)	82	13
Buckeye State (17)	52	12
Novelty (96)	72	12
Enormous (44)	62	11
Fortune (53)	78	11

It is worthy of note that all three of the sets of "Honor Bright" show closely the quality of lateness; likewise both of the sets of "Enormous." Two of three of the "Dwarf Stone" find a place here, and by glancing at the general table it will be noticed that No. 170 came within one of getting a rank also among the early sorts. It was a comparatively heavy bearer from August 1st to September 7th. "Buckeye State" (17), on the other hand, had no early fruits, and the same was true of the "Duke of York," which leads all others for its September pickings. "Giant Climbing" gave a small yield in the height of the tomato season, while "Fortune" was a heavy bearer during the middle of August. The same is true of "Melrose" and "Novelty."

Size of Fruit.

There is much difference in the average size of the fruits of the several varieties of tomatoes. This is regardless of the small-fruited varieties that have taken the names of the various orchard fruits to which they bear some resemblance, namely, "Cherry," "Plum," "Peach" and "Pear," to say nothing of the "Currant," which term is applied to the allied species *Lycopersicum pimpinellifolium* Dunal. In other words, the ordinary commercial tomatoes may be somewhat unsatisfactorily classified under the five groups, very small (v. s.), small (s), medium (m.), late (l.) and very late (v. l.). Among the first group are: "Advance" (3), "Bright and Early" (14), "King Humbert" (64) and "Wonder" (141), while upon the opposite end of the scale of sizes are: "Giant" (56), "Giant Climbing" (57) and "Ponderosa" (103). The remaining three groups contain larger numbers, as, for example, the "small" (s.) has over twenty numbers, the leading sorts being the "Aristocrat" (149) and "Champion" (153) among the dwarfs, and "Acme" (2), "Freedom" (54), "Prizetaker" (158) and "Quicksure" (110) for the standards. Among those classed as "large" (l.) are "Buckeye State" (17), "Crimson Cushion" (27), "Duke of York" (32), "Enormous" (43), "Santa Rosa" (117), "Tree" (132) and "Dwarf Stone" (169).

The group marked "medium" includes the majority of the varieties in the list. These vary somewhat, and with a wider knowledge of them, could be divided into three sub-groups. Of the most pupular sorts, it includes "Beauty" (8), "Perfection" (99), "Favorite" (48), "Trophy" (136), "Atlantic Prize" (6), "Golden Queen" (144), "Mikado" (89), "Matchless" (79), "Honor Bright" (59), "Paragon" (98), "Royal Red" (115) and "Magnus" (73).

Popularity of Varieties of Tomatoes.

From the Bulletin by Mr. Tracy, referred to under the popularity of varieties of sweet corn, it is gathered that of the many kinds of tomatoes grown at the Experiment Grounds this season the following are the most popular among the seedsmen and by inference among the growers of tomatoes.

Name.	Times.	Name.	Times.
Beauty, (8)	187	Matchless (79)	86
Stone, (121)	186	Honor Bright, (59)	81
Champion, (153)	182	Paragon, (98)	80
Perfection, (99)	173	Buckeye State, (17)	76
Favorite, Liv., (48)	162	Royal Red, (115)	76
Acme, (1)	161	Magnus, (73)	71
Ponderosa, (103)	154	Ignotum, (62)	70
Trophy, (136)	135	Imperial, (63)	69
Atlantic Prize, (6)	132	Aristocrat Dwarf, (149)	67
Golden Queen, (144)	108	Early Ruby, (42)	54
Mikado, (89)	103	Crimson Cushion, (26)	52

From the 266 seed catalogues it is seen that eleven are listed more than one hundred times and twice that number over fifty times. Some of the varieties that now take a high rank have come toward the front since the Bulletin above considered was prepared. It is seen that some of these varieties are popular for earliness as shown by their names being in the list of those leading in the first pickings. Other sorts are the standards for the main crop in mid-season.

Scale of Points for Tomatoes.

An attempt has been made to construct a scale of points by which to judge the merits of any ordinary tomato. In other words, a number of the leading characteristices have been estimated separately, and the individual judgments afterwards brought together upon the basis of one hundred units, as is done in the various "scales of points" now in use by live stock men in recording their opinions at fairs and elsewhere.

In the construction of such a "score card" for tomatoes, the difficulties are numerous, and the present one is offered only as a report of progress. Fifty of the one hundred points were arbitrarily assigned to the fruit, and the remaining fifty to the plant as a whole. Naturally, the plant comes before the fruit, but the scheme has been arranged in the order in which the work was carried out; that is, the fruit as a whole was taken first, and its interior qualities were next considered, followed by those of the plant. It is seen that the fifty points for the fruit are considered under ten headings with varying values, as indicated by the number of points at the head of each column. Thus "surface," whether smooth or grooved, etc., is of more consequence than mere "color" or "skin," although a bad color or a weak skin are serious objections. In the same way, "cells" and "flesh" are of more weight than "size" and "shape." A tomato although medium in size and out of shape, if it has small "cells," little pulp and "solid flesh," is still one of much merit.

In the plant itself "form," or desirable habit of growth, is sought. In this the standard varieties are judged separately from the so-called dwarfs. Much stress is put upon "vigor," or ability to thrive under suitable conditions. The "foliage" needs to be "heavy," not "thin," and strong, to resist the hot sun of our mid-summer days and the fungous and other enemies that attack it. Greatest stress of all is laid upon "productiveness," a quality of plant that needs no explanation. Some sorts are more subject to disease than others, from various causes, and a place is given for a record upon this point.

It is not to be inferred that the several characteristics exclude each other, but, contrariwise, they are often inter-dependent. For example, under the fruit proper the size of "cells" is inversely as the amount of "flesh," so that a low mark for "cells" is followed by a low one for "flesh," and *vice versa*. And while few "seeds" is judged 5, the accompanying small seed-cavities calls usually for a high score under "cells" and "flesh." Let the reader take numbers 3 and 4 in the list. It is seen that "Advance" gets 30 points out of a possible 50 upon fruit, and 29 for plant, or a total of 59 points, while "Arcadia," next to it, has 42 for its fruit and the same number of points for plant, giving a total of 84 out of a possible of 100 points for the perfect tomato. It is seen that "Advance" is much below suitable size, and is below standard on "shape," "surface" and "color," while the interior is inferior from its many large "cells" and consequent thin "flesh" and abundant seediness. The fruits decayed badly. The plant was weak in stem and foliage, and yielded almost nothing, losing fourteen points in "product." On the other hand, the "Arcadia" lost only a single point on "shape" (lop-sided), "surface" (slightly grooved), "cells," "flesh," "flavor," "seeds" and "decay." It was up to the standard in productiveness; that is, was among the highest in this season's trials upon the grounds.

The above score of points does not consider the time of maturing of the crop; that is, whether the variety is "early," "medium" or "late," as the seedsmen's catalogues state. So long as earliness is a desirable quality the above rating, it may be claimed, does injustice to those sorts that are bred for a quick turning of a crop. In other words, had there been a place given for earliness in the scheme, such varieties as "Earliana" would have received a higher score than is now accorded them. Such a place was not given in this test, because the scale of points here tentatively adopted was for this set of varieties which, starting out upon the same day (March 4th), has been treated alike so far as possible, regardless of the time of fruiting. Some sorts produce a few fruits and those early, which might suit the trucker, who, getting the cream of the market, clears his ground for some other crop. The man with a garden and a score of tomato plants desires a constant supply of fruit throughout the season. For the up-to-date trucker, the "South Jersey" may bring the most money, but it might be a source of discomfort in the home garden. Those who wish to know how the varieties differed with us in season fruiting may be pleased to consult the table of yields, and, with it in mind, apply the results given in the scale of points.

Scores of Tomatoes Grown in 1904.

	Size.	Shape.	Surface.	Skin.	Color.	Cells.	Flesh.	Flavor.	Seeds.	Decay.	Total for Fruit.	Form.	Vigor.	Foliage.	Product.	Disease.	Grand Total.
MAXIMUM	4	4	7	3	3	7	7	5	5	5	50	5	10	10	15	10	100
1 Acme, Bart	3	4	7	2	3	4	5	4	3	4	39	4	7	8	3	9	70
2 Acme, Liv	...	...	...	...	...	...	...	...	...	4	...	4	8	8	6	9	...
3 Advance, Hlm	2	3	5	3	2	4	5	3	2	1	30	4	7	8	1	9	59
4 Arcadia, Jer	4	3	6	3	3	6	6	4	3	4	42	4	7	8	15	8	84
5 Arcadia, Jer	4	3	5	2	2	6	6	4	3	2	37	4	7	8	8	8	72
6 Atlantic Prize, Btl	4	3	4	3	2	5	6	4	5	4	40	4	8	9	11	9	71
7 Atlantic Prize, Thr	4	2	4	2	2	5	6	3	5	3	38	4	8	7	7	7	81
8 Beauty, Btl	4	3	7	3	2	5	5	4	3	4	40	4	9	9	12	9	83
9 Beauty, Liv	4	3	6	3	2	5	5	4	3	4	39	4	9	9	12	9	82
10 Belmont, Brk	4	3	6	3	2	6	5	4	3	3	40	4	9	8	13	9	83
11 Bermuda, Lan	4	4	5	3	2	5	6	3	5	1	38	4	9	8	9	9	77
12 Best of All, Drr	4	4	6	3	2	5	6	4	4	4	41	4	8	8	15	9	85
13 Brandywine, J. & S	4	3	6	3	2	5	6	4	3	4	40	4	9	8	10	9	80
14 Bright and Early, Vk	2	4	6	2	2	3	5	4	2	1	31	4	8	8	2	9	62
15 Brinton's Best, J. & S	4	3	6	3	2	5	5	3	4	5	40	4	9	8	14	9	84
16 Brinton's Best, Rolfs	4	3	6	3	2	5	5	3	4	5	40	4	9	9	13	9	84
17 Buckeye State, Fer	4	3	6	3	2	5	5	3	5	5	41	4	9	8	11	9	81
18 Buckeye State, Hlm	4	4	6	1	2	6	4	3	5	4	39	4	9	8	11	9	79
19 Canada Victor, Ggy	4	2	5	3	2	3	5	3	3	3	33	4	8	8	9	9	70
20 Cardinal, Liv	3	3	6	3	2	3	5	3	4	3	35	4	8	8	5	9	68
21 Climbing, Chl	4	4	6	2	2	5	5	3	4	5	40	4	9	9	9	9	77
22 Combination, Bur	3	4	7	3	2	3	5	4	3	3	37	4	8	9	3	9	70
23 Combination, Hlm	2	4	7	2	3	3	4	3	3	4	35	4	7	8	3	9	68
24 Conqueror, Liv	4	2	5	3	3	4	4	3	3	1	32	4	8	8	2	8	64
25 Cream City, Cur	3	4	5	1	2	5	4	4	2	1	31	4	8	8	3	9	65
26 Crimson Cushion, Hen	3	3	5	3	2	5	5	4	5	3	38	4	9	8	6	9	74
27 Crimson Whirlwind, Sal	4	2	4	2	2	5	5	3	4	4	35	4	8	8	9	9	73
28 Cumberland, J. & S	4	3	7	3	3	4	4	2	2	2	34	4	8	9	5	9	69
29 Dominion Day, Bru	4	3	5	2	2	5	5	4	4	4	38	4	8	8	11	9	78
30 Democrat, Thr	4	4	6	2	3	5	4	4	2	4	38	4	8	8	9	9	76
31 Diadem, Chl	4	4	5	1	1	5	4	4	3	3	34	4	8	8	7	9	70
32 Duke of York, Rolfs	4	4	5	2	2	5	5	4	4	4	39	4	9	9	15	9	85
33 Earliana, Bru	4	4	6	1	2	5	6	4	3	3	38	4	7	7	10	9	75
34 Earlina, Fer	4	4	6	1	2	5	5	3	3	3	36	4	7	7		9	73
35 Earlina, Ggy	...	...	...	...	...	...	...	...	3	3	...	4	7	7	10	9	...
36 Earlina, Hulsart	4	4	6	1	2	5	4	3	3	3	35	4	7	7	8	9	70
37 Earlina, Rolfs	4	4	6	1	2	4	4	3	3	3	34	4	8	7	9	9	71
38 Earliest of All, Drr	4	2	5	2	2	4	4	4	2	3	32	4	8	8	9	8	69
39 Earliest, Lan	...	...	...	...	...	...	...	...	...	3	...	4	8	8	10	9	...
40 Earliest, Thr	4	3	6	3	2	5	5	4	2	4	38	3	8	8	8	8	73
41 Early Bird, J. & S	4	4	6	2	3	5	5	3	1	1	34	4	8	8	3	8	65
42 Early Ruby, Liv	3	1	4	2	1	3	4	4	2	1	25	4	8	7	7	7	58
43 Enormous, Ggy	4	3	6	3	3	4	5	4	4	4	40	4	9	9	12	9	83
44 Enormous, Hrs	4	4	6	3	3	5	5	4	4	5	43	4	9	9	12	9	86
45 Essex Hybrid, Fer	...	...	...	...	...	...	...	...	...	1	...	4	8	9	2	8	...
46 Everlarge, Lan	...	...	...	...	...	...	...	...	...	1	...	4	9	9	3	9	...
47 Excelsior, Iow	...	...	...	...	...	...	...	...	...	2	...	4	8	9	9	9	...
48 Favorite, Liv.'s Btl	4	4	7	3	3	5	5	4	2	4	41	4	9	9	10	9	82
49 Favorite, Truckers', Bur	4	4	6	2	2	5	6	5	3	4	41	4	8	9	13	9	84
50 Favorite, Liv.'s, Liv	4	4	7	3	2	4	5	4	3	5	41	4	8	9	13	9	84
51 First of All, May	4	2	5	2	2	4	4	3	3	1	30	4	8	8	6	8	64
52 Fordhook, First Jer	4	4	6	2	3	4	5	3	3	3	37	4	8	9	9	9	76
53 Fortune, J. & S	4	3	6	2	2	5	4	3	3	3	35	4	10	9	13	10	81
54 Freedom, Hen	3	4	7	2	1	3	4	3	2	4	33	4	9	9	6	9	70
55 Frogmore, Drr	3	4	6	1	2	3	4	4	3	3	33	4	8	8	2	8	63

Scores of Tomatoes Growing in 1904.—Continued.

	Size.	Shape.	Surface.	Skin.	Color.	Cells.	Flesh.	Flavor.	Seeds.	Decay.	Total for Fruit.	Form.	Vigor.	Foliage.	Product.	Disease.	Grand Total.
56 Giant, Evr.	4	3	3	3	2	3	4	3	5	2	32	4	9	8	8	9	70
57 Giant Climbing, Evr.	4	2	5	3	2	5	5	3	5	3	37	4	10	10	8	10	79
58 Grandus, Liv.	4	3	6	3	3	6	6	3	4	2	40	4	8	8	7	9	76
59 Honor Bright, Btls.	4	3	6	3	2	5	6	3	3	4	39	4	9	8	11	9	80
60 Honor Bright, Brk.	4	3	5	3	2	5	5	3	3	5	39	4	9	8	12	9	81
61 Honor Bright, Liv.	4	3	6	3	1	5	6	3	3	5	39	4	9	8	12	9	81
62 Ignotum, Hlm.	4	1	5	2	3	6	6	4	5	4	40	4	9	9	12	9	83
63 Imperial, Drr.	4	4	6	3	3	6	7	4	4	3	44	4	9	9	10	9	85
65 King of the Earlies, Rolfs	4	4	5	1	3	5	6	4	4	3	39	4	7	8	3	8	69
66 Jewel, Bur.	4	2	5	2	3	6	6	3	4	4	39	5	9	8	10	9	80
67 La Crosse Seedling, Sal	..	...	...	...	...	...	...	...	...	1	...	4	6	9	1	8	..
68 Leader, Vick	3	2	5	2	2	2	3	3	1	1	24	4	7	8	3	7	53
69 Liberty Bell, J. & S	4	4	6	2	2	5	5	3	3	4	38	4	8	8	10	9	77
70 Longkeeper, Evr.	4	4	7	3	3	4	5	4	1	3	38	4	8	8	8	8	74
71 Lorillard, Elt.	4	4	7	2	3	4	5	3	1	4	37	4	8	8	9	9	75
72 Magnificent, Mau.	4	4	7	3	2	4	3	3	3	4	39	4	8	8	13	9	81
73 Magmus, Drr.	...	...	...	...	...	...	...	...	...	4	...	4	8	8	10	9	...
74 Magnus, Evr.	...	...	...	...	...	...	...	...	...	4	...	4	8	8	11	8	...
75 Magnus, Ggy.	...	...	...	...	...	...	...	...	...	4	...	4	9	9	9	9	..
76 Magnus, Liv.	4	4	7	2	2	4	4	5	3	4	39	4	9	9	13	9	83
77 Marvel, Drr	4	4	7	2	2	5	6	5	2	3	40	4	9	8	6	9	76
78 Marvel, Drr. 2nd.	4	4	7	3	3	5	5	4	3	4	42	4	9	8	13	9	85
79 Matchless, Btl.	3	4	7	3	3	4	5	4	3	4	40	4	9	8	11	9	81
80 Matchless, Fmr.	...	...	...	...	...	...	...	...	...	4	...	4	9	8	12	9	...
81 Matchless, Rolfs.	4	4	6	3	3	4	5	3	3	5	40	4	9	8	14	9	84
82 Matchless, Thr.	...	...	...	...	...	...	...	...	...	4	...	4	9	8	11	9	...
83 Mayflower, Drr	3	3	6	3	2	4	3	4	3	5	36	4	9	8	11	9	77
84 Melrose, Hlm.	4	3	6	2	2	5	5	2	2	4	35	4	9	8	15	9	80
85 Michigan, Fer.	4	3	6	2	2	5	5	2	2	4	35	4	9	8	14	9	79
86 Michigan, Hlm.	4	4	6	3	2	4	6	4	3	4	40	4	9	8	12	9	82
87 Minnesota, Ggy.	2	4	7	2	2	3	3	2	3	3	31	4	8	8	3	9	63
88 Mississippi, Chl	3	4	6	3	2	4	4	4	2	4	36	4	9	8	9	9	75
89 Mikado, Evr.	4	2	5	3	1	4	5	4	3	1	32	4	8	8	2	8	62
90 Mikado, May.	4	3	7	3	3	6	6	4	4	1	41	4	8	8	6	8	75
91 Moneymaker, Lan.	4	1	6	3	3	2	4	3	3	3	32	4	7	8	10	8	69
92 Multicolor, Liv.	3	4	6	3	2	5	6	3	3	2	37	4	7	7	6	9	70
93 New Jersey, Thr.	4	3	6	2	3	5	5	3	3	5	39	3	7	8	13	7	77
94 Nolte's Earliest, Fer.	4	3	5	3	2	6	5	4	5	3	40	3	7	7	12	8	77
95 Nolte's Earliest, Ggy.	4	2	4	3	2	6	5	4	5	3	38	3	7	7	13	8	76
96 Novelty, Thr.	4	4	6	2	2	5	5	3	3	4	38	4	9	8	10	9	78
97 Optimus, Fer.	3	3	6	3	2	5	4	4	4	4	38	3	8	8	8	8	73
98 Paragon, Liv.	4	3	6	2	3	5	5	4	4	4	40	4	9	8	13	9	83
99 Perfection, Btl.	4	4	6	2	3	4	5	4	3	4	39	3	8	8	10	9	77
100 Perfection, Liv.	4	3	7	3	3	5	4	4	3	4	40	3	8	8	12	8	79
101 Picture Rock, Chl.	4	3	6	3	3	5	6	3	3	4	40	3	8	8	10	7	76
102 "Pink," Hulsart.	4	3	6	3	3	5	6	3	3	3	39	3	9	8	9	9	77
103 Ponderosa, Hen.	3	4	4	2	1	6	5	4	5	1	35	4	9	9	7	10	74
104 Potato Leaf, Liv.	4	3	6	2	3	5	4	3	2	3	35	4	8	8	8	8	71
105 Potomac, Hrs.	3	4	6	3	2	4	5	4	3	3	37	4	8	8	8	7	72
106 Pres. Cleveland, Fqr.	4	3	6	3	2	4	4	3	3	3	35	4	9	8	8	9	73
107 Prizetaker, Hlm.	4	3	6	3	2	3	5	4	3	3	36	4	9	8	6	9	72
108 Prizetaker, Hlm. 2nd.	3	4	6	3	2	5	5	4	3	3	38	4	9	8	9	9	77
109 Princess, Liv.	4	3	6	3	2	5	5	4	4	1	37	4	8	7	6	9	71
110 Quicksure, Iow.	4	3	5	3	2	3	5	3	4	4	36	4	8	9	9	9	75
111 Richmond, Lan.	4	2	5	3	2	4	4	3	4	1	32	4	7	7	6	5	61
112 Rosalind, Thr.	4	3	6	3	1	4	4	4	4	1	34	4	8	9	2	9	66
113 Rose Peach, Liv	2	3	4	3	1	3	4	2	3	1	26	3	9	8	2	9	57
114 Royal Colors, Liv.	4	3	6	3	2	3	5	4	3	1	34	4	9	8	2	9	66
115 Royal Red, Btl.	4	2	5	2	2	5	5	4	4	4	37	4	8	8	11	9	77
116 Royal Red, Liv.	4	2	5	2	2	5	6	4	4	4	38	4	8	8	11	9	78
117 Santa Rosa, J. & S.	3	2	4	2	2	6	5	3	5	3	35	3	8	8	11	9	74
118 Shipper's Choice, Ham.	4	4	7	3	2	5	6	4	3	4	42	4	8	8	9	8	79
119 South Jersey, Liv.	4	4	3	3	2	5	4	3	4	4	36	3	7	8	15	8	77
120 Stirling Castle, Elt	3	4	7	2	2	4	5	4	3	4	38	4	9	8	1	9	69
121 Stone, Btl.	4	4	7	3	2	4	6	4	3	4	41	4	8	8	13	8	82
122 Stone, Hulsart.	4	3	6	3	2	4	6	4	3	4	39	4	8	8	10	8	77

Scores of Tomatoes Grown in 1904.—Continued.

	Size.	Shape.	Surface.	Skin.	Color.	Cells.	Flesh.	Flavor.	Seeds.	Decay.	Total for Fruit.	Form.	Wigor.	Foliage.	Product.	Disease.	Grand total.
123 Stone, Liv.	4	4	6	3	2	4	6	4	3	4	40	4	8	8	14	8	82
124 Stone, Rolfs.	4	3	6	3	2	4	6	4	3	4	39	4	8	8	8	8	75
125 Success, Bur.	4	4	7	2	2	4	5	4	3	4	39	4	8	8	14	8	81
126 Success, Mau.	4	4	6	2	3	5	6	4	3	4	41	4	9	8	11	8	81
127 Success, May.	4	3	6	2	2	5	6	4	4	4	40	4	9	8	9	8	78
128 Sut's? Best of All, Thr.	4	3	6	3	2	6	5	3	4	4	40	4	8	8	11	8	79
129 Table Gueen, May	...	...	...	...	...	...	...	...	...	3	...	4	8	8	6	8	...
130 Terra Cotta, Thr.	3	4	6	3	1	4	4	3	3	3	34	4	8	8	9	8	71
131 Tree, Kuttawa Dwf., Evr	4	3	6	3	2	4	5	3	3	3	36	4	8	9	3	10	70
132 Tree, Ham.	3	1	5	3	2	6	5	3	3	4	35	4	8	8	8	7	70
133 Tree, Giant, Fmr.	4	3	7	3	3	5	5	4	2	3	39	5	9	9	2	9	73
134 Tree, Giant, May.	3	2	4	3	3	6	7	3	3	5	39	4	9	9	5	9	75
135 Tree, Giant, Sal.	4	4	7	2	3	5	5	4	3	3	40	4	8	8	10	8	78
136 Trophy, Drr.	4	3	5	2	2	5	5	4	3	5	38	4	8	8	10	8	76
137 T.T.T., Lan	4	3	6	3	2	4	5	3	3	4	37	4	9	8	13	9	80
138 T.T.T., Rolfs.	4	4	6	3	3	3	6	3	3	4	39	4	8	8	11	8	78
139 Volunteer, Liv.	4	3	7	3	2	5	5	4	4	3	40	4	8	8	8	8	76
140 Waldorf, Thr.	4	2	5	2	3	4	5	3	3	4	35	4	9	8	8	9	73
141 Wonder, Elt.	...	...	...	...	...	...	...	...	...	3	...	4	8	8	2	9	...
142 $5,000,000, Sal	...	...	...	...	...	...	...	...	...	3	...	4	9	9	9	9	...
143 1903, Thr.	4	4	7	3	2	4	5	5	3	1	38	4	8	9	6	9	74
144 Golden Queen, Btl.	4	3	6	3	3	4	5	5	3	2	38	4	9	8	9	8	76
145 Golden Queen, Liv.	4	4	6	3	2	3	3	4	3	4	36	4	8	8	10	8	74
146 Golden Sunrise, Exp't Sta	...	...	...	...	...	...	...	...	...	4	...	4	8	9	6	8	...
147 Lemon Blush, Thr.	4	3	6	2	3	4	6	4	3	3	38	4	8	8	8	9	75
148 Yellow Prince, Liv.	4	3	6	2	2	4	5	3	3	5	37	4	8	9	6	9	73
149 Aristocrat, Fmr.	4	4	6	2	3	5	5	3	3	3	38	4	8	9	7	9	75
150 Aristocrat, Hlm.	2	4	6	2	3	6	5	3	4	4	39	4	8	9	6	9	75
151 Aristocrat, Liv.	3	...	...	...	...	...	...	...	...	5	...	4	8	9	3	9	...
152 Aristocrat, Vau.	4	3	6	2	3	5	5	3	3	5	39	4	8	9	7	9	76
153 Champion, Btl.	4	4	7	2	3	4	5	3	3	4	39	4	8	9	7	9	76
154 Champion, Brk	3	4	6	3	2	5	6	4	3	3	39	4	7	8	3	9	70
155 Champion, Hen.	4	3	6	2	3	4	4	3	3	3	35	4	8	8	2	9	66
156 Champion Scarlet, Brk.	4	3	6	3	3	5	5	3	2	3	37	4	8	8	7	9	73
157 Champion Scarlet, Vau.	4	2	5	2	3	5	5	4	4	2	36	4	8	8	6	9	71
158 Dandy Dwarf, Liv.	...	...	...	...	...	...	...	...	...	1	...	5	7	7	2	8	...
159 Extra Early Tree, May.	3	3	6	2	3	4	4	4	3	5	37	4	8	8	11	9	77
160 Fordhook Fancy, Thr.	4	3	6	2	3	4	4	3	3	3	35	4	8	9	7	9	72
161 Kansas Standard, Btl.	4	4	6	3	2	5	6	4	3	4	41	4	8	9	7	9	78
162 Kansas Standard, Bur.	...	...	...	...	...	...	...	...	...	4	...	4	8	9	8	9	...
163 Modek, Vau.	4	4	7	2	3	5	6	3	4	4	42	4	7	8	5	9	75
164 Purple Dwarf, Liv.	...	...	...	...	...	...	...	...	...	4	...	4	8	8	6	9	...
165 Quarter Century, Bur.	3	4	7	2	3	...	...	...	...	4	...	4	8	9	8	8	...
166 Quarter Century, Thr.	...	...	...	...	...	...	...	...	...	4	...	4	8	9	11	8	...
167 Station Upright, Chl.	4	3	6	3	3	5	5	3	4	4	40	4	8	8	7	8	75
168 Station Upright, Thr	4	4	6	3	3	5	5	3	4	4	41	4	7	8	6	9	75
169 Stone, Dwarf, Hulsart.	4	4	7	3	3	4	6	4	3	5	43	4	10	9	13	9	88
170 Stone, Dwarf, Liv.	4	4	7	2	3	5	5	4	3	5	42	4	10	9	15	9	89
171 Stone, Dwarf, Thr.	...	...	...	...	...	...	...	...	...	4	...	4	10	9	11	9	...

From the above score of the tomatoes as grown upon the trial grounds for the past season it is gathered that the followihg thirty-three record numbers received a rank of over eighty points as follows:

Points.
89 Dwarf Stone, Liv. (170).
88 Dwarf Stone, Hulsart (169).
86 Enormous, Hrs. (44).
85 Best of All, Drr. (12).
Duke of York, Rolfs. (32).
Imperial, Drr. (63).
Marvel, Drr. (78).
84 Arcadia, Jer. (4).
Brinton's Best, J. & S. (15).
Brinton's Best, Rolfs. (16).
Favorite, Truckers, Bur. (49).
Favorite, Livingston's. Liv., (50).
Matchless, Rolfs. (81).
83 Beauty, Btl. (8).
Belmont, Brk. (10).
Enormous, Ggy. (43).
Ignotum, Hlm. (62).
Magnus, Liv. (76).
Paragon, Liv. (98).

Points.
82 Beauty, Liv. (9).
Favorite, Livingston's, Liv. (48).
Michigan, Hlm. (86).
Stone, Btl. (121).
Stone, Liv. (123).
81 Atlantic Prize, Btl. (6).
Buckeye State, Fer. (17).
Fortune, J. & S. (53).
Honor Bright, Brk. (60).
Honor Bright, Liv. (61).
Magnificent, Mau. (72).
Matchless, Btl. (79).
Success, Bur. (125).
Success, Mau. (126).

It is noted that "Dwarf Stone" leads in two numbers that "Brinton's Best" holds the same place whether the seed was northern or southern grown and that the "Stone" has two of its numbers alike while the other from seed grown in the State a short distance from the Station scored five points less. "Success" was alike in two sets of plants and the third six points lower.

Proposed Classification of Tomatoes.

The following is an attempt to group the varieties of tomatoes under test so that they might be more easily studied.

A Standards not "potato leaved."
    B Fruit red.
        C Fruit small.
            D Season early.
                Advance (3).
                Bright and Early (14).
            DD Season medium.
                Combination 22, 23).
                Freedom (54).
                Frogmore (55).
                Stirling Castle (120).
                Wonder (141).
        CC Fruit medium.

- **D** Season early.
  - **E** Fruit smooth.
    - Arcadia (4, 5).
    - Earliana (33-37).
    - Earliest (40).
  - **EE** Fruit rough but round.
    - Bermuda (11).
    - Nolte's Earliest (94, 95).
    - King of the Earlies (65).
    - Richmond (111).
    - South Jersey (119).
  - **EEE** Fruit rough and flat.
    - Atlantic Prize (7).
    - Canada Victor (19).
    - Earliest of All (38).
    - Early Ruby (42).
    - First of All (51).
    - Leader (68).
    - Moneymaker (91).
- **DD** Season medium early.
  - Atlantic Prize (6).
  - Best of All (12).
  - Cumberland (28).
  - Dominion Day (29).
  - Earliest (39).
  - Marvel (77, 78).
  - Michigan (85, 86).
  - Mississippi (88).
  - Picture Rock (101).
  - President Cleveland (106).
  - Quicksure (110).
  - Sutton's Best of All (128).
  - Tree Giant (135).
  - Trophy (136).
  - T.T.T. (137, 138).
- **DDD** Season medium.
  - Belmont (10).
  - Brandywine (13).
  - Brinton's Best (15, 16).
  - Cardinal (20).
  - Conqueror (24).
  - Crimson Whirlwind (27).
  - Diadem (31).
  - Everlarge (46).
  - Favorite (Livingston) (48-50).
  - Ignotum (62).
  - Jewel (66).
  - Liberty Bell (69).
  - Lorillard (71).
  - Matchless (79-82).
  - New Jersey (93).
  - Optimus (97).
  - Paragon (98).
  - Perfection (99, 100).
  - Royal Red (115, 116).
  - Shipper's Choice (118).
  - Stone (121-124).
  - Success (125-127).
  - $5,000,000 (142).
  - 1903 (143).

- **DDDD** Season late.
  - Honor Bright (59-61).
  - Novelty (96).
  - Fortune (53).
- **CCC** Fruit large.
  - Crimson Cushion (26).
  - Enormous (43, 44).
  - Santa Rosa (43, 44).
- **BB** Fruit purple.
  - **C** Fruit small.
    - Acme (1, 2).
    - Early Bird (41).
    - Minnesota (87).
    - Potomac (105).
    - Prizetaker (107, 108).
  - **CC** Fruit Medium.
    - **D** Season medium early.
      - Excelsior (47).
      - Fordhook First (52).
      - "Pink" (102).
      - Table Queen (129).
      - Terra Cotta (130).
      - Waldorf (140).
    - **DD** Season medium.
      - Beauty (8, 9).
      - Democrat (30).
      - Imperial (63).
      - Longkeeper (70).
      - Melrose (84).
      - Rosalind (112).
    - **DDD** Season medium late.
      - Buckeye State (17, 18).
      - Favorite (Tucker's) (49).
      - Grandus (58).
  - **CCC** Fruit large.
    - Duke of York (32).
    - Giant (56).
    - Giant Climbing (57).
    - Ponderosa (103).
    - Tree, Giant (132).
- **BBB** Fruit yellow.
  - Golden Queen (144, 145).
  - Golden Sunrise (146).
  - Lemon Blush (147).
- **AA** Standard "potato-leaved."
  - **B** Fruit red.
    - Red Mikado.
  - **BB** Fruit purple.
    - **C** Foliage yellowish.
      - Multicolor (92).
      - Princess (109).
    - **CC** Foliage not yellowish.
      - Magnus (73-76).
      - Mikado (89, 90).
      - Potato leaf (104).
- **AAA** Dwarfs.
  - **B** Fruit red.
    - **C** Fruit small.
      - Aristocrat (149-152).
      - Dandy Dwarf (158).

CC Fruit medium.
Champion Scarlet (156, 157).
Extra Early Tree (150).
Kansas Standard (161, 162).
La Crosse Seedling (67).
Quarter Century (165, 166).
Station Upright (167, 168).
CCC Fruit large.
Dwarf Stone (169, 170)
BB Fruit purple.
C Fruit small.
Champion (153-155).
Fordhook Fancy (160).
CC Fruit medium.
D Somewhat "potato-leaved.
Model (163).
Royal Colors (114).
DD Not at all "potato-leaved."
Kuttawa Dwarf Tree (131).
Purple Dwarf (164).
BBB Fruit yellow.
Station Yellow.
Yellow Prince (148).
AAAA Small fruited.
B "Currant" form.
Currant (177).
BB "Cherry" form.
C Fruit red.
Red Cherry (176).
CC Fruit Yellow.
D Fruit very small.
Yellow Cherry (183).
DD Fruit small.
Gold Ball (172).
Golden Nuggett (174).
CCC Fruit pale yellow.
Ivory Ball (175).
White Apple (182).
BBB "Plum" form.
C Fruit red.
D Fruit very small.
Red Plum (180).
DD Fruit small.
King Humbert (64).
CC Fruit yellow.
Golden Fig (173).
Sumatra Fig (181).
Yellow Plum (187).
BBBB "Peach" form.
C Fruit red.
Red Peach (178).
CC Fruit Purple.
Rose Peach (113).
CCC Fruit yellow.
Yellow Peach (186).

Field Notes for the Season.

The accompanying field notes upon the varities of tomatoes which follow in the order of the above scheme of classification are kindly provided by Mr. Shaw who had charge of the tests at the gardens.

No garden plant has appeared in so many variable forms in so few years of cultivation as the common garden tomato. Certain types date back to the wild state of the plant, and distinct forms have appeared from time to time in cultivation. These have varied so greatly under the influence of changing environment and natural and artificial inter-crossing that the varieties now under cultivation present much confusion.

There are three distinct types of plants to be found among the common garden varieties, the usual type or "standard" tomatoes, the "potato-leaved" and the "dwarf" sorts. These three groups, together with a fourth, containing certain "small" varieties of minor account, furnish the basis of the preliminary classification here presented. Each of these four divisions presents varieties bearing fruits of three distinct colrs, red, purple and yellow, with the exception of the the "potato-leaved" group, in which, so far as the writer's knowledge goes, there is no yellow variety. The red-fruited "standard" varieties are sub-divided upon the size of the fruit into "small," "medium" and "large." The "small" sorts are again divided according to season. The "early" sorts include "Advance" (3) and "Bright and Early" (14). Somewhat later in season are "Combination" (22, 23), "Freedom" (54), "Frogmore" (55), "Stirling Castle" (120) and "Wonder" (141). All these, while smooth, vigorous growing and prolific, are very small.

The "medium-sized" varieties are divided into "early," "medium early," "medium" and "late" sorts. The "early" sorts are again divided into "smooth," "rough and round" and "rough and flat." The "smooth" sorts are "Arcadia" (4, 5), "Earliana" (33-37) and "Earliest" (40). The "Earliana" is a distinct variety, introduced by Johnson and Stokes in 1900. With us it was scarcely as early as some, but no other early tomato exceeded it in the production of marketable fruits. It is a leader among the early tomatoes. Seed from five sources were planted. No differences could be detected, except that No. 37, from Professor Rolfs, of Florida, was later and more vigorous. "Arcadia" could not be distinguished from "Earliana." "Earliest" (40) was productive, but the fruit was not so uniformly smooth as the "Earliana."

The next group, "rough and round," were early and productive, especially "Nolte's Earliest" (94, 95) and "South Jersey" (119), but they were inferior in appearance to the "Earliana." "Richmond" (111) was badly affected by the "blight," but this may have been due in part at least to its location at the end of a plot next to the "weed plot," referred to elsewhere. The varieties in the next group bore fruits distinctly more flattened than those in the last "Atlantic Prize" (7), "Earliest of All" (38), "Early Ruby" (42), "First of All" (5) and "Leader" (68) were very similar. The fruits were much subject to the rot, and the leaflets were thin and curled.

The "medium early" sorts are fifteen in number. They fall between the early and the main-crop varieties, and lose much of their value on that account. The "Trophy" (136) was the first of the modern garden tomatoes introduced, and it has held a place for more than thirty years. "Michigan" (85, 86) has been much grown, but with us it was a little under-sized. "Marvel" (77, 78), "Best of All" (12) and "T. T. T." (137, 138) are other varieties worthy of cultivation.

The next group, "season medium," includes many of the best known commercial varieties. "Belmont" (10) and "Brinton's Best" (15, 16) were somewhat alike, reasonably smooth and productive. "Diadem" (31) is peculiar, in having markings like bits of gold leaf on many of the fruits. There are two distinct varieties known as "Favorite." The best known of the two is "Livingston's Favorite" (48, 50), which is distinguished from "Trucker's Favorite" (49) by its red color. "Jewel" (66) or "Chalk's Early Jewel" is a new sort, bearing some resemblance to the "Michigan." It is not as early as some have claimed, but is a handsome tomato for the mid-season. "Matchless" (79, 82) is valuable for the main crop. "New Jersey" (93) is not as well known as some, but seems to be worthy of consideration. "Paragon" (98) is one of the oldest and best varieties on the list, while "Perfection" (99, 100) resembles it, but is a little earlier in season. "Stone" (121-124) is one of the leading main-crop sorts at present. It is of good size and shape, and productive. "Success" (125-127) is, perhaps, a little larger, but otherwise not widely different.

"Under "season late" are "Honor Bright" (59, 61), "Novelty" (96) and "Fortune" (53). The first is a marked variety which has been highly recommended for long-distance shipping. The fruits are at first pale green, and pass through a waxy white and lemon yellow to a yellowish red, the changes occupying two or three weeks. The foliage is also yellowish, and the color of the ripened fruit is not attractive. "Fortune" produced especially vigorous plants, which were fairly productive, but the fruit, while of good size, was rather soft and thin walled.

The varieties producing "large" fruits were "Enormous" (43, 44), "Crimson Cushion" (26) and "Santa Rosa" (117). The first was the best of these, producing a large number of well-shaped fruits all through the latter part of the season. "Santa Rosa" is a new sort which with us produced large ill-shaped fruits.

In many markets a purple ("pink") tomato is preferred. Varieties of this color are not as numerous as the red ones, but there are enough to permit a wide choice. They are divided into three classes, according to the size of the fruit. The five "small" sorts are all medium early in season, and are usually too small for profitable marketing. "Acme" (1, 2) is the best known of these, and possibly the small size of the fruits with us may have been partly due to an unfavorable location. The medium-sized sorts are separated according to season, into "medium early," "medium" and "late." None of the "medium early" sorts made especially good records with us. "Pink" (102) is a strain grown by C. C. Hulsart, of Matawan. It is of fine appearance, but lacked productiveness. Among the "medium" varieties is "Beauty" (8, 9), which is perhaps the best known of the purple sorts, being handsome, vigorous and productive. The "Imperial" (63) has a solid fruit, of good appearance. "Melrose" (84) probably belongs here, though only three plants were of this type, two others being red, and the sixth yellow-fruited, all from seed of the same packet. Somewhat later in season are "Buckeye State" (17, 18), "Grandus" (58) and "Trucker's Favorite" (49). The first is a variety worthy of attention, being of good size and productive. "Grandus" is called a "purple-fruited Honor Bright." It resembles that variety in its color changes and yellowish foliage. One of the plants in this set was "potato-leaved." "Terra Cotta" (130) is evidently a cross of some garden sort with the "peach" tomato, it being larger than the "peach" but having the same peculiar "bloom." The third class of "large" purple tomatoes contains four varieties. The "Duke of York" (32) made the best showing with us, being productive and with a large proportion of the fruit smooth enough for market. The "Giant" (56) and the "Giant Climbing" (57) were distinct sorts of the old rough tomato, and of but little value commercially. "Ponderosa" (103), the best known of this group, is large and "meaty," but many of the fruits are irregular, and it is much subject to decay. The fruits do not mature evenly.

There are three yellow-fruited varieties among the "standard" sorts. "Golden Queen" (144, 145) is the better known, while "Lemon Blush" (147) is perhaps superior to it, having fruits more firm or solid.

The "potato-leaved standards" are comparatively few, and nearly all of them bear purple fruits. The "Red Mikado" was not grown, and is inserted merely to make the classification more complete. "Multicolor" (92) and "Princess" (109) had the peculiar yellow foliage that appears in less degree in "Honor Bright." The "Magnus" (73, 75, 76) is vigorous, though somewhat lacking in productiveness, but the fruit is of excellent shape. It seems to be the best "potato-leaved" tomato. No. 74 was not true to name, being a red tomato, and not "potato-leaved." "Mikado" (89, 90) and "Potato Leaf" (104) were not distinguished from each other. The location of the former on the end of the plot was unfavorable, and may account for its small product and high percentage of decay.

A special effort was made to obtain a large number of "dwarf tomatoes, and eighteen varieties were grown. These are first separated according to the color of the fruit, and secondly upon size. The small red varieties are "Aristocrat" (149-152) and "Dandy Dwarf" (158). "Aristocrat" (150) proved to be a purple sort, resembling "Champion."

Among the medium-sized red tomatoes, "Quarter Century" (165, 166), "Kansas Standard" (161, 162) and "Extra Early Tree" (159) made good showings. All were superior to the better known "Champion." The "Dwarf Stone" (169-171) is a new variety, introduced by Livingston in 1902. The fruits were uniformly of large size, and the plants were healthy, vigorous and productive. Our experience the past summer indicates that it is the best dwarf, and a variety well worthy of cultivation.

The purple-fruited dwarfs are separated upon size, being rated as either "small' or "medium." "Champion" (153-155) is the best known and perhaps the best of the purple-fruited sorts, but it is inferior to several of the red-fruited varieties. "Model" (163) and "Royal Colors" (114) appear to be cross of a "dwarf" and a "potato-leaved" sort.

Two yellow-fruited "dwarfs" were grown—the "Station Yellow," which is a variety originated at this Station from a cross of a "Champion" and "Golden Sunrise," and "Yellow Prince," which somewhat resembles it.

The varieties grouped together as "small sorts" include a number of varieties, developments of the "pear," "plum," "peach" and "cherry" tomatoes, as well as the "Currant," which is a separate species. The characteristics of these are well shown in the table of classification. None are of especial value from a commercial standpoint.

Eight varieties of tomatoes were received from the Bureau of Seed and Plant Introduction of the Department of Agriculture. No. 3147 was a red sort, of the "plum" type, closely resembling "King Humbert" (64). Nos. 3150 and 3151 were similar to this, but with yellow fruits. No. 3153 was of the common type, early, but irregular, watery and full of seeds. No. 3158 was a very small red tomato, intermediate in form between the "plum" and "pear" types. All of the above came from Italy. No. 3623, from Smyrna, was an irregular red sort, and No. 4491, "Prince Bismark," from Italy, was a large, rough, yellow "peach" tomato. No. 6091, from Russia, was the best of these, being red in color, of good size, and fairly smooth, but in no way superior to many of our native sorts.

A Second Crop of Tomatoes.

Seeds from the following earliest varieties of tomatoes, namely, "Arcadia," "Earliana," "Red Cherry" and "Red Pear," were sown for a second crop, in the usual way, late in July, and the plants afterwards set in the trial grounds. As with the second crop of corn, the early frosts interfered with the growth of these plants, but by giving them shelter during the coldest nights fruit was obtained from all the varieties of practically full size, and thereby seeds were secured for further use. At least two weeks might have been gained at the beginning of the first crop in early spring, and thus made it easy to have secured a second crop from these and other quick-growing sorts in an ordinary season without any guarding against the cold nights.

EXPERIMENTS WITH BEANS.

Crosses of Lima Beans.

Since 1900 work has progressed upon crosses between the "Henderson" as the male and the "Burpee" as the female parent. The history of this breeding is given from year to year in the annual reports for the past four years, together with the characteristics of the parent varieties, and those of the crosses that have been made from them.

In report for 1900 (page 430) is a plate showing the half-opened pod of a "Henderson" and a "Burpee" variety, and of two crosses between them. At page 392 of the report for 1901 a plate shows heaps of the dry seeds and of the fresh seeds of the parents, with corresponding heaps of a cross in comparison with them. In last year's report, at page 490, is a plate of seeds and leaves of five varieties of dwarf limas, including the "Henderson" and the "Burpee," and piles of seeds of six of the developing crosses.

Thirteen selected crosses were planted the present year, and of these numbers 5, 12 and 13 resembled more nearly the "Burpee" parent, while numbers 1, 4 and 11 were of the "Henderson" type. The other numbers, 2, 3, 6, 7, 8, 9 and 10, were nearly intermediate in all respects. Plate VII. shows sample pods and seeds of the thirteen crosses above considered. The quality of the above crosses compares favorably with that of the "Burpee," a variety of high grade but lacking in productiveness.

Out of the above crosses two have been selected, and one, nearer the "Burpee" than the "Henderson," is named the Station Bush Lima, and the other, approaching the "Henderson" type, is called the Kelsey, after Mr. J. A. Kelsey, a former assistant, who for years cared for these crosses in their culture and selection.

Notes Upon Bush Lima Beans.

The following twenty-one numbers (80–100) of Bush Lima Beans were planted side by side across a plot and gave a length of row for each sort of thirty-one feet.

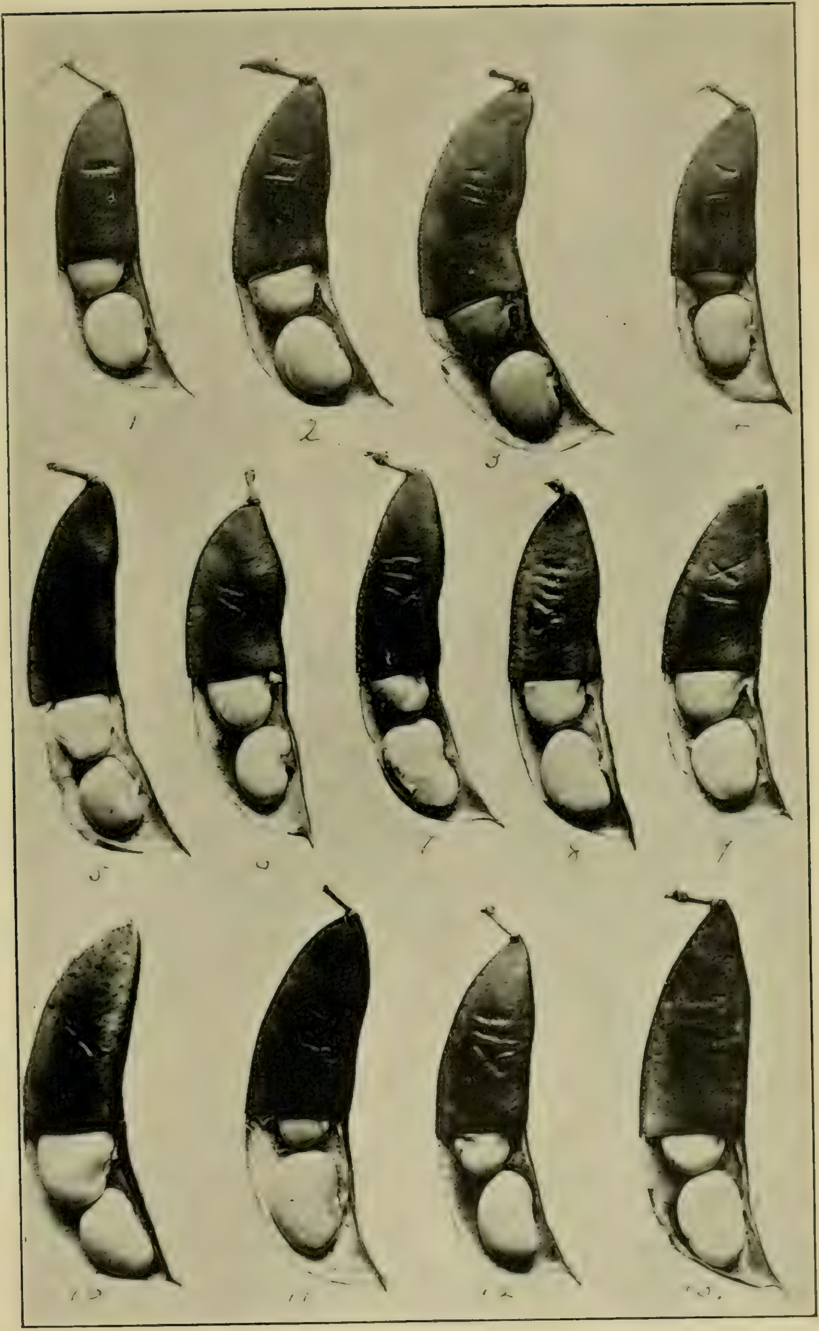

PLATE VII. Samples of the "Burphends" ("Burpee" and "Henderson") crossed Lima Beans from 1 to 13 grown in 1904.

No.	NAME AND SOURCE.	Number of Pods.	Number of Seeds.	Average per Pod.	Weight in Pounds.	Popularity.
80	Burpee's Bush Cole.	396	720	1.8	1 ¾	
81	" " (Earlier) Cole.	334	573	1.7	1 ⅛	191
82	" " Bart.	98	162	1.6	⅜	....
83	" " Cox	462	764	1.6	1 15-16	...
84	" " Burp.	240	410	1.7	⅞	...
85	" " Hol.	391	682	1.7	1 7-16	....
86	Dreer's " Cole.	300	758	2.5	1 11-16	71
87	" " Drr.	184	331	1.8	1 10-16	...
88	Dreer's Wonder Bush. Drr.	386	605	1.5	1 1-16	..
89	Henderson's New Bush. Hen.	623	1,466	2.3	2 11-16	161
90	" Bush. Cox.	955	2,139	2.2	2 ⅞	....
91	Jackson Wonder. Cur.	1,250	2,597	2.0	2 ⅞	24
92	Kumerle Bush. Fer.	443	762	1.7	2 3-16	15
93	Dwarf, Large White. Fer.	118	192	1.6	7-16	3
94	Salzer's New Bush. Sal.	65	135	2.0	1 3-16	....
95	Wonder Bush. Cox.	259	547	2.1	2 1-16	4
96	Wood's Prolific Bush. Wd.	1,075	2,059	1.9	2 7-16	9
97	Willow Leaf Lima. May.	1,360	2,759	2.0	2 13-16	2
98	Wood's Prolific. Mau.	696	1,389	1.9	1 ⅜	...
99	Wood's New Prolific. Vk.	664	1,142	1.7	1 5-16	.
100	Wonder Bush. Fer.	199	332	1.6	¾	....

The above test of the leading varieties of bush lima beans shows a great range in number of pods, seeds, etc. Among the "Burpee" group, the row with California grown seed (83) did the best, with 462 pods and 764 seeds, weighing 1 15-16 pound. In the same way, the "Dreer" seed (86) from the Pacific Coast was superior to that from the East. Again, the same thing is true with the "Henderson" (90), which, by the way, is the leader in yield for the whole plot.

The "Jackson Wonder" (91) gave much the largest number of pods and seeds, but the latter are thinner than the "Henderson," and do not exceed the latter in total weight. Number 91 differs also in the seeds, being marked with brown, which imparts a color to the cooked product that may not be altogether desirable.

Plate VIII. shows a sample pod and seeds of each of the twenty-one numbers that were grown in the gardens during the present season.

Notes Upon Pole Lima Beans.

Fifteen rows of pole lima beans were planted on May 10th in Plot 1, Series II, and alternate hills were pruned from time to time in an attempt to dwarf them. The remaining hills received poles and were permitted to grow in the usual manner. The following table gives some of the facts concerning this group of beans.

No.	NAME AND SOURCE.	Number of Poles.	Number of Seeds	Number of Pods.	Average per Pod.	Weight in Pounds.	Popularity.
65	Imp. Early Bearing. Burbank. ...	12	179	352	1.9	1 1-16	....
66	Challenger. Cole.	9	119	352	2.9	15-16	34
67	Earliest Golden. Ham.	6	218	420	1.9	1 ¼	2
68	New Evergreen. J. & S.	12	143	261	1.8	¾	....
69	Imp. Early Lima. Sal.	4	190	236	1.2	½	....
70	Ford's Mammoth. J. & S.	6	62	169	2.7	7-16	30
71	Ford's Mammoth. Wood.	9	153	388	2.4	15-16	....
72	King of the Garden. Cox.	14	161	358	2.2	15-16	136
73	Panmure Extra Early. Mau.	2	266	568	2.1	1 ¼	....
74	Seibert. Cox	10	312	664	2.1	1 13-16	39
75	Seibert. J. & S.	11	169	354	2.0	⅞	....
76	Imp. Salem. J. & S.	2	58	100	1.7	5-16	4
77	Imp. Shotwell. J. & S.	8	500	988	1.9	15-16	1
78	Large White. Btl.	4	478	819	1.7	2 3-16	136
79	Imp. Pole. Wood.	3	135	313	2.3	½	....

It is seen that the "Panmure" (73) and "Large White" (78) were the most productive while the "King of the Garden" (72) and "New Evergreen" (69) with the largest number of vines gave small returns. The "Challenger" (66) led in the largest average of seeds to the pod followed closely by "Ford's Mammoth" (70). The "Improved Early" (69) was particularly low in this regard.

The following numbers have large flat seeds not easily distinguished when shelled namely, Nos. 65, 67, 68, 71, 72, 73, 74, 75 and 76. The smallest seeds are those of No. 79 while Nos. 66, 69, 70, 77 and 78 are medium in size.

It is interesting to note that the two most popular pole lima beans, namely, "Large White" (78) and "King of the Garden" (72), gave such widely different results in the present trial.

The column marked "October pods" contains the marketable

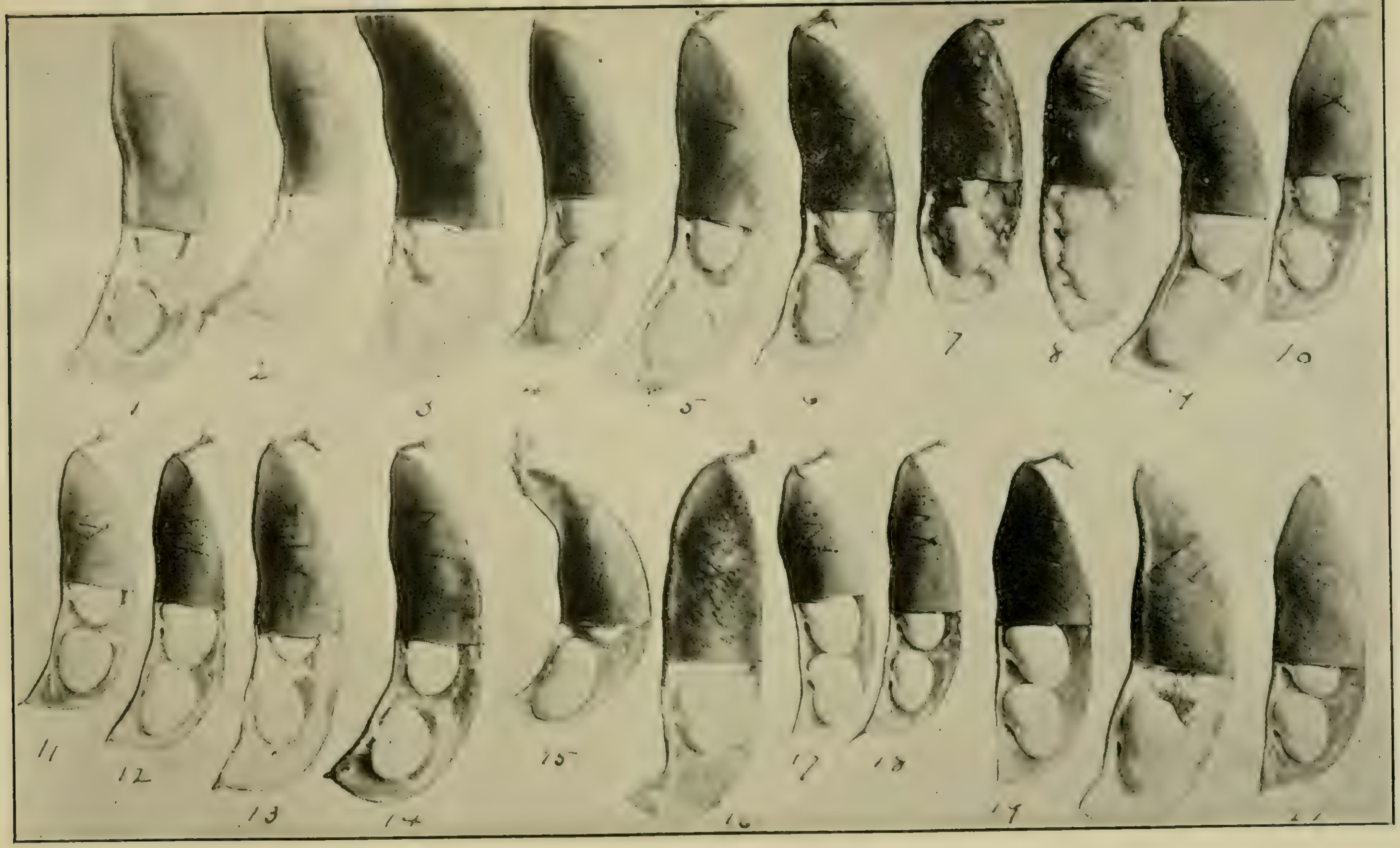
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PLATE VIII. Samples of the twenty-one lots of Bush Lima Beans that were grown in 1904.

green pods at the final harvest, late in the season. It is seen from a glance at the marketable green pod at the final harvest that "Imp. Shotwell" and "Large White" produce late, while "Panmure," "Ford's Mammoth" and "King of the Garden" ripen their crop comparatively early.

It is seen that "King of the Garden" and "Large White" are equally popular, and far exceed any other sorts in this regard.

Pruned Limas.—The pole lima that were pruned showed a remarkable tendency to twine, and needed pinching back almost weekly. The small portion of each plant that was left to grow bloomed freely, and seeds were saved for a continuation of the experiment in the coming season.

Green Pod Bush Beans.

A set of green pod bush beans, embracing fifty-six numbers, (1 to 56), was planted on May 5th in rows side by side, each being sixteen feet in length. With the exception of No. 7, they all made a good stand of plants. On half of each row, that is, eight feet was left to grow and mature its crop without any crossing upon that portion, and none of the green pods were picked for testing the quality. The following table shows some of the facts connected with this trial. The weights of vines, indicating size and vigor, show that there was much variation, in fact, all the way from 7¾ pounds for the "Canadian Wonder" (8), California-grown seed, to 9-16 of a pound in "Extra Early Valentine" (48). The weight of the mature, but not entirely dry, pods is more to the point, for this is more nearly a measure of the marketable product. The "Burlington Medium" (5) is a trifle ahead of "Bountiful Bush" (2), with 2½ pounds. This is a variety with a long slender pod of fine size, while "Bountiful" has a shorter and broader pod that is inclined to curve. Something of the relative size and shape of the pods of the several varieties may be seen in Plate IX , where all excepting No. 7 are shown. That No. 5 had larger pods than No. 2 is shown in the next column in the table. It is also shown that the "Bountiful" averages just one seed more per pod than the "Burlington."

Yield of Green Pod Bush Beans.

No.	NAME AND SOURCE.	Weight of Vine.	Weight of Pods.	Number of Pods.	Number of Seeds.	Seeds per Pod.	Popularity.
1	Best of All. Hlm.	3 1-8 lbs.	1 1-8 lbs.	190	651	3.4	80
2	Bountiful Bush. Hen.	5 9-16 "	2 7-16 "	225	676	2.9	6
3	Boston Snap. Brk.	2 ¾ "	1 "	254	815	3.2	...
4	Breck's String and Shell. Brk.	5 ¼ "	1 ¾ "	160	605	3.7	1
5	Burlingame Medium. Brk.	4 5-16 "	2 ½ "	200	784	3.9	8
6	Byer's Bush. Chl. (3 vines).	2 9-16 "	1 7-16 "	200	737	3.6	4
7	Canadian Wonder. Thr.	2 ⅞ "	1 1-16 "	35	60	1.4	26
8	" " Cox.	7 ¾ "	2 15-16 "	218	726	3.3	...
9	China Red Eye. N. K.	1 ¼ "	¾ "	61	189	3.0	17
10	Crystal. Drr.	2 1-16 "	1 3-16 "	300	1,117	3.7	...
11	Dwarf Chocolate. Thr.	3 13-16 "	1 ¾ "	250	928	3.7	1
12	Dun Colored. Thr.	1 ¾ "	¾ "	125	373	2.9	2
13	Eclair. Thr.	4 5-16 "	1 5-8 "	260	580	2.2	...
14	Earliest G. P. Bush. Ham	3 3-16 "	1 9-16 "	192	606	3.1	...
15	Emperor of Russia. Thr.	2 1-16 "	1 "	187	608	3.2	1
16	Emperor William. Hlm.	15-16 "	5-16 "	65	148	2.2	16
17	Everbearing. Thr.	13-16 "	7-16 "	135	375	2.7	9
18	Imp. Goddard. Fer.	2 15-16 "	1 ¾ "	125	390	3.1	24
19	Dwarf Horticultural. Btl	2 1-8 "	1 5-16 "	135	401	2.9	124
20	" " Hen.	2 1-8 "	1 5-16 "	158	503	3.1	...
21	Snap or Horticultural. N. K.	4 1-8 "	2 "	175	568	3.2	...
22	Marblehead Horticultural. Fer.	1 5-8 "	⅞ "	168	534	3.1	3
23	First on Market. Lan.	1 "	7-16 "	85	275	3.2	5
24	Landreth's Scarlet. Lan.	2 ⅞ "	1 ¼ "	165	700	4.2	...
25	Lightning. Thr.	1 9-16 "	15-16 "	130	356	2.7	2
26	Longfellow. Hen.	1 11-16 "	13-16 "	150	585	3.9	9
27	Low's Champion. Ggy.	1 ⅞ "	13-16 "	100	340	3.4	29
28	White Marrowfat. Btl.	1 11-16 "	11-16 "	150	490	3.2	...
29	" " Hlm.	4 1-16 "	1 5-16 "	175	451	2.5	57
30	Marvel of Paris. Thr.	2 7-16 "	1 1-8 "	274	1,060	3.8	2
31	Early Mohawk Dwf. Drr.	2 11-16 "	1 ¼ "	120	390	3.2	138
32	" " Bush. Thr.	4 1-16 "	1 5-8 "	225	644	3.8	...
33	" " Green. Bru.	1 13-16 "	15-16 "	120	425	3.5	...
34	Prolific Tree. Iow.	5 ⅞ "	1 ¾ "	275	1,000	3.6	41
35	Refugee. Btl.	2 11-16 "	1 7-16 "	150	490	3.2	115
36	" Green. Bru.	4 3-16 "	2 "	285	1,172	4.0	...
37	The Silver. Sal.	3 ½ "	15-16 "	150	486	3.2	...
38	Silver Bush. Mau.	1 ⅜ "	12-16 "	302	1,153	3.8	...
39	Burpee Stringless. Btl.	2 7-16 "	11-16 "	160	506	3.1	137
40	Mammoth Stringless. Drr.	1 13-16 "	1 "	200	657	3.2	...
41	Stringless Dwarf. Thr.	2 "	¾ "	150	407	2.7	...
42	Giant Stringless. Wd.	2 1-8 "	1 3-16 "	251	754	3.0	...
43	Tennessee. Fer.	2 9-16 "	1 1-16 "	100	332	3.3	...
44	Earliest R. Valentine. Hen.	1 7-16 "	1 1-16 "	235	868	3.6	31
45	Black Valentine. Hen.	1 7-16 "	13-16 "	215	806	3.7	3
46	Stringless Valentine. Btl.	1 1-16 "	5-8 "	195	794	4.0	...
47	Early Red Valentine. Btl.	1 ⅜ "	⅞ "	200	820	4.1	...
48	Extra Early Valentine. Nk.	9-16 "	⅜ "	115	412	3.5	...
49	Dwarf Prolific Pickler. Vk.	2 15-16 "	1 3-16 "	137	434	3.1	2

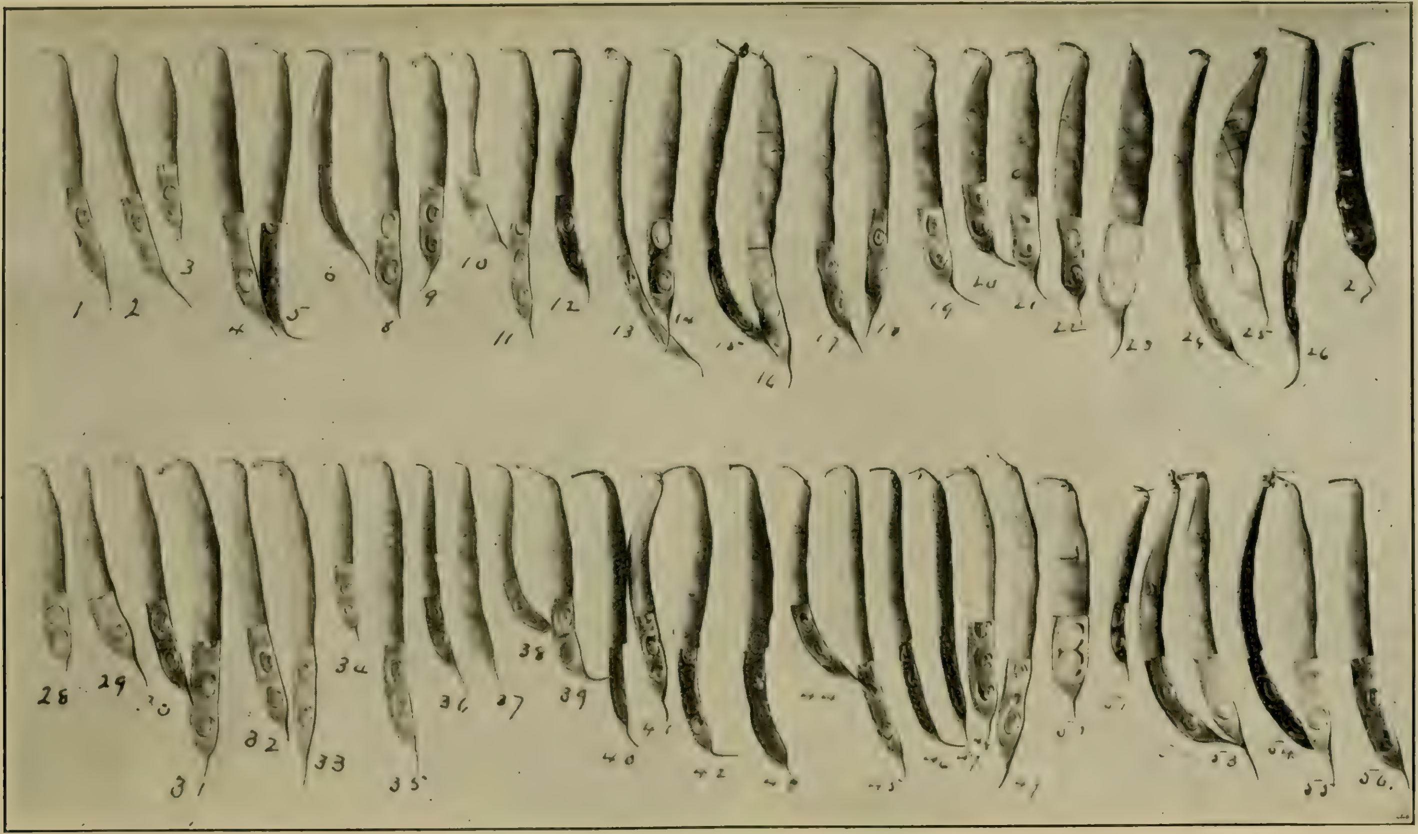
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PLATE IX. A Group of Green Pod Bush Beans taken when of marketable size and showing the seeds only partly developed.

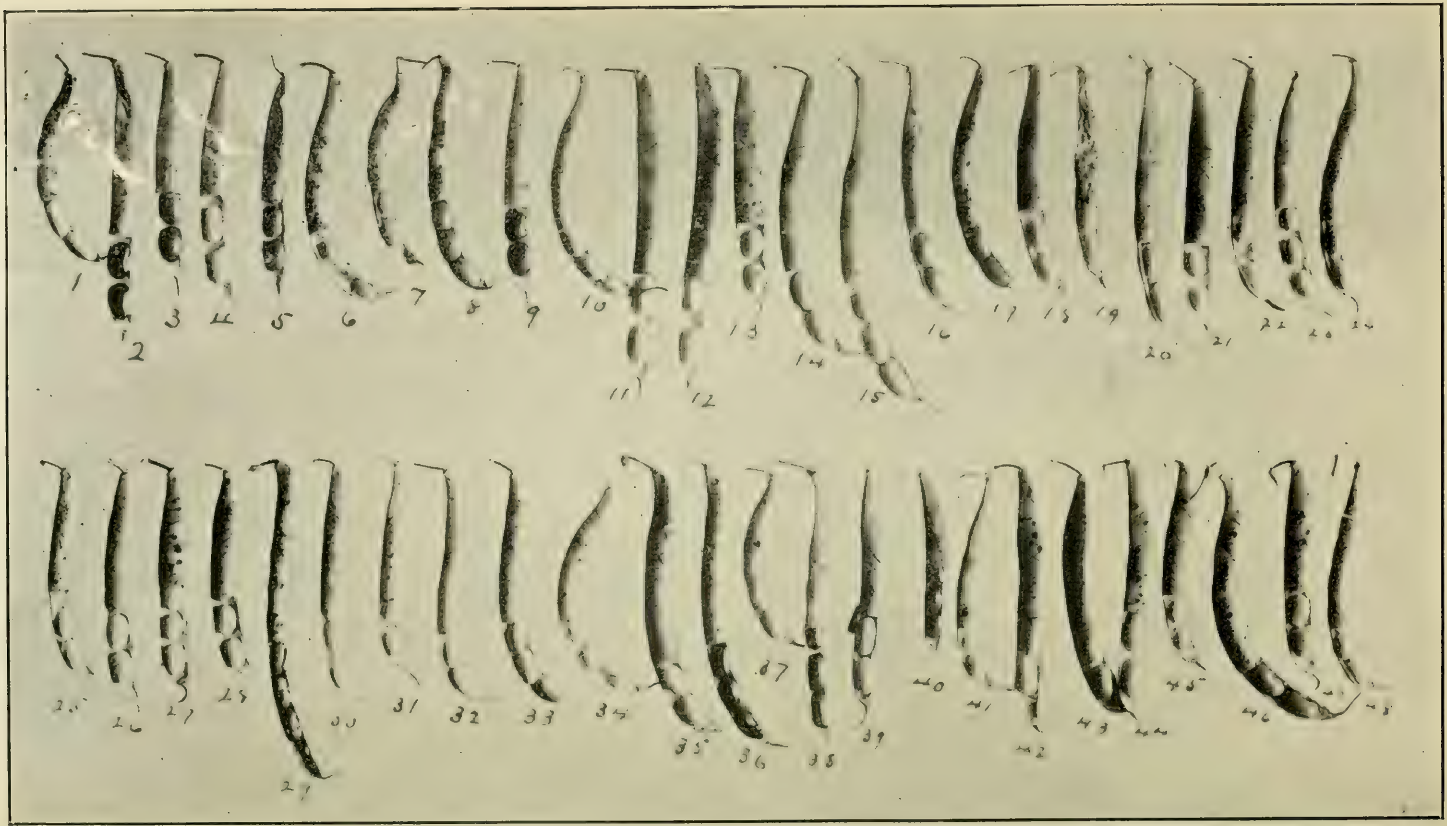
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PLATE X. A group of Wax Bush Beans taken when the seeds are of full size and showing the injury in many instances of the pod spot disease.

Yield of Green Pod Bush Beans.

No.	NAME AND SOURCE.	Weight of Vine.	Weight of Pods.	Number of Pods.	Number of Seeds.	Seeds per Pod.	Popularity.
50	Warren Bush. Ggy.	1 5-8 lbs.	13-16 lbs.	125	341	2.6	14
51	Green Winter. Sal.	1 5-8 "	15-16 "	285	1,040	3.6	...
52	Wonder of France. Brk.	1 "	9-16 "	243	645	2.5	7
53	Early Yellow 6 weeks. Btl.	1 9-16 "	⅞ "	115	320	2.7	36
54	" " 6 " Bru.	1 ½ "	13-16 "	207	596	2.8	...
55	Long " 6 " Drr.	1 ¼ "	1 1-16 "	180	470	2.6	81
56	Early " 6 " N. K.	3 7-16 "	1 7-16 "	235	974	4.1	...

The "Landreth Scarlet" (24) is seen to be the most seeded, the average being 4.2 per pod, while the "Eclair" (13) and "Emperor William" (16) yielded near half as many seeds. The "Eclair" has a very long slender pod, and when ready for market the seeds make up a very small part of the pod. On the other hand, the "Emperor William" has a long, wide pod; that is, these two sorts low in seed contents are almost opposites in the make-up of their pods.

The greatest number of pods, 302 and 300, were produced by Nos. 38 and 10, respectively, both of which have pods of small size, and the two sorts are in other ways much alike. The "Silver Bush" (38) is a very little more seedy than the "Crystal Wax" (10). The "First of All" (23) has a very large flat pod, while the "Warren" (50) has an equally wide pod, but not much more than half the length of No. 23.

Enough has been said to indicate that there is great variation in form and size of the pods. There are many other important differences that are not indicated in Plate X., such as tenderness and the presence or absence of the fibers along the back of the pod, that is termed the "string." This plate indicates something of the age of pods that are at their best for the table. It is not possible to get the best results unless the pods are picked before the seeds are of full size, and when much younger than this they are still more delicate, but the yield is correspondingly reduced.

Classification of Green Pod Beans.

Upon the color and size of the seeds the following preliminary classification of the green pod beans may be made:

- I. *White* Seeds.
    - 1. Small. Crystal (10), Prolific Tree (34), The Silver (37), Silver Bush (38), Winter (51).
    - 2. Medium. Boston Snap (3), Emperor William (16), Everbearing (17).
    - 3. Large. First on Market (23), Marrowfat (28-29).
- II. *Black* Seeds.
    - 1. Small. Valentine (15).
    - 2. Large. Warren (50).
- III. *Green* Seed.
    - 1. Wonder of France (52).
- IV. *Red* Seeds.
    - 1. Medium. Champion (27).
    - 2. Large. Canadian Wonder (7-8),Land. Scarlet (24), Pickler (49).
- V. *Seal Brown.* Chocolate (11), Dun Colored (12), Stringless (39-41).
- VI. *Light Brown.* Bountiful (2), Burlingame (5), Eclair (13), Stringless (40, 42, 46), Tennessee (43), Six Weeks (53-56).
- VII. *Mottled Brown and Red.* Best of All (1), String and Shell (4), Earliest (14), Empress of Russia (15), Goddard (18), Horticultural (19-22).
- VIII. *Mottled Brown and Pink.* Longfellow (26), Valentine Red (44, 47, 48.
- IX. *Mottled Dark Brown.* Byers (6), Marvel of Paris (30), Mohawk, (31-33), Refugee (35-36).
- X. *Mottled Grey.* Lightning (25).
- XI. *Pink Eye* China (9).

Wax Bush Beans.

On May 4th a set of forty-eight including a few duplicates wax bush beans was planted in rows side by side. A half of each sixteen-foot row was permitted undisturbed to grow and mature its crop, while the remaining half was used for crossing, and from this portion pickings were made of the young pods to make a test of the quality, so far as possible. The following table shows some of the facts obtained in this trial:

Yield of Wax Beans.

No.	NAME AND SOURCE.	Weight of Vines.	Weight of Pods.	Number of Pods.	Number of Seeds.	Seeds per Pod.	Popularity.
101	Brittle Wax Bean. Bur.	3 ⅞ lbs.	1 11-16 lbs.	160	550	3.5	1
102	Bismarck. Far.	3 14-16 "	1 ¾ "	207	718	3.5	3
103	Black Wax. Bart.	2 1-8 "	1 1-16 "	175	571	3.3	80
104	Dwarf Black Wax. Bart.	2 3-16 "	1 3-16 "	160	622	3.9	...
105	Dwarf Black Butter. Bru.	2 14-16 "	1 7-16 "	148	729	4.8	...
106	Prolific German. J. & S.	5 ¼ "	2 9-16 "	231	837	3.6	59
107	Imp. Prolific. Thr.	2 9-16 "	1 6-16 "				
108	Challenger. Thr.	2 15-16 "	1 7-16 "	255	770	3.0	54
109	Currie Rust-Proof. Cur.	3 5-16 "	1 ½ "	175	607	3.4	10
110	Cylinder. Hlm.	5 9-16 "	2 5-8 "	200	675	3.4	4
111	Davis Kidney Wax. Btl.	3 7-16 "	1 ⅞ "	142	500	3.5	68
112	" " " N. K.	4 ¼ "	1 ⅞ "	209	677	3.2	...
113	Detroit Wax. N. K.	3 15-15 "	2 1-8 "	160	575	3.6	51
114	Flageolet Gg. Pod. Bru.	4 7-16 "	2 ⅜ "	155	515	3.3	...
115	" Scarlet. Fer.	5 "	2 15-16 "	132	467	3.5	32
116	Fuller's Ringleader. J. & S.	3 ⅜ "	1 11-16 "	195	711	3.6	1
117	Fuller Black Wax. Ggy.	1 5-16 "	13-16 "	173	510	3.0	2
118	Golden Wax. Btl.	2 9-16 "	1 7-16 "	185	602	3.2	172
119	" " Bru.	3 13-16 "	*2 1-16 "	§210	730	3.5	...
120	" " N. K.	3 ½ "	1 13-16 "	178	682	3.8	...
121	Imp. Golden Wax. Cox.	3 11-16 "	2 "	237	756	3.2	...
122	" " " Hen.	2 9-16 "	1 7-16 "	248	625	2.7	...
123	Dwarf Golden Wax. Fer.	3 12-16 "	1 6-8 "	223	700	3.1	...
124	German Black Seeded. Fer.	5 1-8 "	1 ⅞ "	320	1020	3.1	25
125	Golden Crown. Thr.	3 ⅜ "	1 9-16 "	200	685	3.4	2
126	Keeney's Golden. Fer.	7 1-16 "	3 ½ "	211	658	3.1	40
127	Grennell's Golden. Fer.	1 1-16 "	2 1-16 "	238	748	3.1	11
128	" " Fer.	3 3-16 "	1 11-16 "	192	630	3.3	...
129	Golden Scimita. Hen.	6 "	2 ¾ "	209	736	2.7	...
130	Golden Eyed. Thr.	4 5-16 "	2 "	247	772	3.1	95
131	Jones' Stringless. Vau.	3 15-16 "	1 10-16 "	196	654	3.3	22
132	Keeney's Imp. Refugee. J.&S	5 5-16 "	3 "	280	918	3.2	3
133	Keeney's Refugee. Hlm.	4 "	2 1-16 "	231	693	3.0	...
134	Round Kidney. J. & S.	2 15-16 "	1 ¼ "	135	468	3.4	12
135	Market Wax. Hen.	3 ⅞ "	1 13-16 "	184	620	3.3	1
136	Dwarf Pencil Pod. Fer.	3 ⅜ "	1 5-8 "	135	609	4.4	...
137	New Profusion. Mau.	3 15-16 "	2 1-8 "	240	644	2.6	...
138	Landreth's Scarlet. Lan.	3 9-16 "	1 7-16 "	133	801	6.0	7
139	Refugee. N. K.	3 3-16 "	1 3-16 "	184	690	3.7	59
140	Stringless. Ham.	2 1-8 "	1 1-16 "	194	617	3.2	...
141	Saddleback. Hlm.	3 ½ "	1 ½ "	235	700	3.0	25
142	Wardwell's Kidney. N. K.	1 ½ "	¾ "	95	283	3.0	165
143	" " Btl.	2 11-16 "	1 2-16 "	164	436	2.6	...
144	" " Bur.	2 ¼ "	1 "	144	442	3.0	...
145	Crystal White. Fer.	1 5-8 "	1 1-16 "	320	1,396	4.3	32
146	Yosemite Mammoth. Drr.	5 ⅜ "	1 13-16 "	192	206	1.1	66
147	Allan's Imperial. Sal.	2 ½ "	1 5-16 "	250	672	2.7	5
148	Livingston's Pencil Pod. Liv.	3 9-16 "	1 15-16 "	219	637	2.9	11

*1 Vine ¾ lb.

§1 Vine 7-16 lb.

In the first column are the weights of the vines at harvest time, and they range from over seven pounds for "Kenney's Golden" (126) to 1 1-16 pound for "Grennell's Golden" (127), that stood next to the first named. In other respects these two sorts were not so widely different, as is shown by the weights of the pods, namely, 3½ and 2 1-16 pounds, respectively; in fact, the lighter weight of vines is followed by a larger number of pods and seeds, while the number of seeds to pod is the same for both. The two varieties with greatest number of pods are "German Black Seeded" (124) and "Crystal Wax" (145), the former a black and the later a white-seeded variety, and quite the opposite in general appearance. These two sorts lead also in the number of seeds, the smaller white ones being in excess of the larger black ones, and bringing the average for the former up to 4.3 per pod. The "Yosemite" (146) stood high in weight of vines (5 3-8 pounds), but had only 192 pods, with 206 seeds, or an average of but little more than one to the pod. Next to this in seedlessness is "New Profusion" (137), with an average of 2.6, which is equalled by one of the "Wardwells" (143). The most seedy of all the forty-eight numbers is "Dwarf Black Butter" (105), which has nearly five (4.8) seeds, and the next is "Dwarf Pencil Pod" (136), with an average of 4.4 per pod. The former is a long, straight, flat member of the black-seeded type, while the latter has a long curved pod with seed also black.

The palatableness of a dish of wax beans is dependent upon many things, some of which are outside of the variety of the bean. Tenderness seems to count for more than anything else, and this requires that the pods be properly cooked soon after they are picked. As a general thing, the pods are picked after they have passed the point most acceptable for food. In other words, the pods need to be picked as soon as the seeds begin to change the outline of the surface of the pod. This may be while the pods are too small to yield the desired profit to the market gardener. The expert housewife decides that a string (or stringless) bean pod is good when it will snap off like a pipe-stem. Wilted pods fail in this test, as also do those that remained upon the vines until the pod toughens, becomes stringy and the seeds are evident from the outside. Such pods are still more objectionable when the variety is black-seeded, and then the large beans discolor the whole in the process of cooking. Plate X. shows a set of the pods of the forty-eight numbers of wax beans, each nearing maturity.

Weight of Wax Beans.

The number of marketable pods per pound was taken of some of the large, medium and small podded varieties, and the following range was determined:

No.	Name.	Number of pods to the pound.
102.	Bismarck	120
103.	Black Wax	120
104.	Dw. Black Wax	120
105.	Dw. Black Butter	120
115.	Flagolet Scarlet	72
119.	Golden Wax	110
124.	German Bk. Seeded	104
129.	Golden Scimitar	74
132.	Keeney's Imp. Refugee	118
137.	New Profusion	116
139.	Refugee	90
142.	Wardwell's Kidney	80
145.	Crystal White	184
146.	Yosemite Mammoth	70
148.	Livingston's Pencil Pod	110

It is seen that the "Yosemite" is the largest, followed closely by "Flageolet," "Golden Scimitar" and "Wardwell's Kidney." The Crystal White" is much the smallest variety, and the black and golden wax sorts may be taken as average in size of pods, when ready for market.

Classification of Wax Beans.

I. *White.* Davis (2), Golden Crown, Jones, Stringless, Crystal.
II. *Black.* Bismarck, Black Wax (6-, Rust Proof, Cylinder, Fuller (2), German, Scimitar, Pencil, Landreth's. Saddleback, Yosemite.
III. *Red.* Flageolet.
IV. *Orange-Yellow.* Market.
V. *White Eyemarked* Brittle, Detroit, Golden Eyed, Kidney, Wardwell's (3).
VI. *Mottled, Pink and White.* Golden Wax (6), Keeney's Golden, Grennell's (2), Allan's.
VII. *Mottled, Pink and Dark.* Keeney's Refugee (2), Profusion, Refugee, Pencil Pod.

Crossing Among the Beans.

Much time was given to cross-pollination among the beans during the season, and it is too soon to determine what success has resulted from this work. The large number of varieties was grown primarily to study them with the end of combining the best qualities of the superior sorts. The immediate result or an attempted cross has been termed a "suspect," and some of those obtained early in the season with wax beans have been grown for their first generation, with the result that a few were able to mature before the frosts put an end to their growth.

It is noted that seeds have been obtained as a result of "working" "Bismarck" (102) upon "Detroit" (113); that is, a variety ("Detroit") with large oval white seeds with a large mottled "eye" was pollinated with a variety ("Bismarck") which has a long seed that is uniformly black. The result is a seed that is black and mottled brown, and near the shape of the male parent. It is as if the mottled "eye" of the "Detroit" had become spread over the whole seed, but, more than that, the shape of the seed is nearly that of the "Bismarck."

In a second case, instead of the "Detroit," the "Bismarck" was worked upon "Keeney's Refugee" (133), which has a long seed mottled throughout with two shades of brown. The result is a bean that, while having nearly the same shape as No. 133, has a fine blue as the background, with flecks of a lighter shade. This is a bean strikingly different from any of the forty-eight numbers grown as wax beans this season.

In a third case, with the "Bismarck" remaining in the same position, the female was "Grennell's Golden" (127), which has an oval seed of good size, and with a mottled "eye" that extends well out into the otherwise white skin of the seed. The seeds resulting are near to the "Grennell" in the markings, but the shape is more flat, possibly due to partial maturity. It will require the second generation to decide whether there is any cross in this case.

A fourth attempt was with "Bismarck" as the female and the "Davis Kidney" as the pollinizer. In this case the male parent has a solid white slender seed of medium size, the "Bismarck" being black, as before described. The result here is a seed of solid color, which is between seal brown and black. Neither the white or the black controlled, and there is no tendency to become streaked or mottled.

Some other cases will need the next generation to give sufficient proof to warrant the opinion that the cross was actually made. Beans are easily self-fertile, and the stamens of a flower may have deposited pollen upon the stigma before their removal by the breeder.

Beans from the Department of Agriculture.

Twenty-four packets of beans, mostly native of Mexico, were received from the U. S. Department of Agriculture, and a row of each sort was planted in the gardens. They all showed marked vigor, and a tendency to run and cover all the space of two feet between the rows. At the time when the wax and green podded variety of beans were in bloom no flowers had appeared upon these, and they blossomed only sparsely in the season.

Only three varieties matured any seed, namely, Number 9404 and 9405, the first a brown, and the latter a black bean, and No. 3382, a white-seeded sort. The other numbers, all of which failed, were 9147 to 9160 and 9438 to 9444, and No. 10,544.

This test suggests that for their complete development these beans require a much longer season than the common garden bush beans, and possibly a warmer or drier climate. There was no opportunity to secure any crosses the present year, but the few seeds secured from the three sorts may be earlier and more prolific next season.

Field Notes Upon Bush Beans.

The following notes are kindly furnished by Mr. E. J. Owen, who had immediate charge of the beans upon the experiment grounds:

GREEN PODDED BEANS.—Fifty-six varieties of Green Pod Beans were grown at the gardens during the past season, and all came up well excepting "Canadian Wonder" (7), which showed the least vitality, and was represented by only a half-dozen plants. The vines as compared with the wax beans grown near by are of a larger growth, and number 8, also "Canadian Wonder" (California-grown seed), was noted especially for its large, erect vines, with dark green leaves and broad pods, fully seven inches long. This set of bush beans was planted May 9th, and nearly all of them were in bloom on June 22d. A majority of them were ready for market on July 2d, making the average time of 56 days from planting to picking. A later planting (July 21st) was ready for picking in about 50 days.

The "Lightning" (25) takes first place in respect to earliness, while "Crystal Wax" (10) is among the first in the list in desirable qualities. The former is not "viny," has an erect growth, comes into bloom four or five days ahead of the other varieties, and produces dark green flat pods of medium length, ready for market 50 days from time of planting. This variety led all others for the season in the second crop from 1904 seed by blooming 28 days after planting. It does not, however, rank with the most prolific, nor is it a stringless variety. The seed when ripe are flat and mottled. "Crystal Wax" (10), on the other hand, produces much vine, and has a tendency to run. It is among the latest to bloom and pod for market, but ranks as one of the most prolific varieties. The round, plump, medium-sized pods of a very light green color are stringless during the marketable stage. The seeds being white cause the pods to be marketable for a longer time than No. 25. Also, the beans when dry are excellent for cooking. In fact, the color of the seed is an important quality in bush, or string, beans, the white or light sorts being most desirable.

"The Silver" (37) and "Silver Bush" (38) are very similar to No. 10 in respect to vine and fruit.

"Prolific Tree" (34) was found to be desirable, because of its bearing quality and the excellent flavor of its crisp, round stringless pods.

The pod-spot, which attacked the bush beans quite badly during the rainy "spell," was not so prevalent with the green pods as with the wax beans.

It is to be noticed that a larger percentage of hand pollinations between varieties of green pod beans are more successful than among the wax sorts. For example, five hundred trials among the former gave thirty suspected crosses, while a thousand of the latter resulted in only twenty "suspects."

WAX BEANS.—On May 4th forty-eight rows of wax beans were planted, representing about thirty-five varieties. All came up well, and were in bloom on June 13th. The leaves were noted as being of a lighter green than those of the green-podded sorts. Fifty-seven days after planting, the pods of all varieties were ready for market, with the exception of Nos. 126, 138, 139, 145 and 148.

A second planting from the commercial seed, made June 11th, began blooming on July 9th, and on July 24th the earliest were ready for picking. A third planting from the commercial packets, on July 19th, matured before any danger of frost.

On July 21st a planting from seed of the first crop was made for the purpose of obtaining any "suspects" liable to result from natural crossing of the varieties. These began blooming August 24th, 34 days after planting.

Several varieties were tested at the table, and No. 145, "Crystal Wax," stood second to none, possessing all those qualities mentioned under No. 10 in the green-pod notes. It would seem that the same variety is sometimes placed in both groups of these bush beans. "Yosemite Mammoth" (146) is of fine quality, having a large, round, yellowish pod, with less seeds than the black wax sorts, is not stringy, and has a flesh of excellent flavor.

The Black Wax varieties are good as to productiveness, earliness and color, but they soon get too large for eating, and the color of their seed is not desirable.

All the white-seeded varieties did well, and a separate planting was made of these, in order to effect crosses among them the more readily. Owing to the lateness of the season, but four mature "suspects" were obtained. The "Golden Wax" stands high as to color and productiveness, but is more string and less tender than some varieties mentioned above. Among the desirable characteristics of the wax beans are earliness, productiveness, and light-colored, large, round stringless pods, containing few white seeds.

Seed Holders for Beans, Etc.

In the study of the many varieties of beans, it is necessary to have the seeds, for example, so that all of a group may be brought under the eye at a glance. In the case shown at the top of Plate XI, are the fifty-six sets of seeds of the green pod bush beans, extending from the upper left-hand corner to the empty pocket in the third row. Thus, "Best of All" (1) is at the corner named, and, passing along the upper row, the corresponding corner on the right is occupied with seeds of "Lightning" (25), and just below it, upon the end of the second row, is "Warren" (50). The small white sorts are easily seen near the middle of the second row, namely, "Crystal" (10), "Prolific Tree" (34), "The Silver" (37) and "Silver Bush" (38). Any differences in the seeds of these three numbers are quickly detected. As a matter of fact, they are all much alike. The medium-sized white seeds are easily located, as "Boston Snap" (3), "Emperor William" (16) and "Everbearing" (17). The last two are of the same long type, while No. 3 is a plump oval bean. The "large" include "First on Market" (23), which is a flat bean, somewhat resembling the limas of the Sieva type, and the pair at 28 and 29 are both "white marrowfats," and are seen to be practically alike.

When it comes to the other beans, the reds, browns, and even the mottled sorts, give nearly the same dark appearance in the engraving, but the differences are quickly distinguished in the tray.

It only need be said in passing that the case is one that once served for holding dram vials filled with weed seeds. By removing the vials, the pockets are filled with the bean seeds, and a glass front is then fitted to the case, and the seeds, being all large, are held securely, and are easily seen beneath the transparent cover.

The pole and lima beans that were under experimentation this season fill up the remaining portion of the case. The latter are so nearly the same whitish color that they differ to the eye chiefly in size. The last twenty-one pockets, 80 to 100, are filled with dwarf limas, and among these, near the middle, the "Jackson Wonder" (91) is strikingly evident because of its dark color, in fact a dull red mottled with black.

A special holder, shown in the lower part of Plate XI., was made for the wax beans by boring shallow 1½-inch pits in a cherry board and fitting a glass cover to slide close to the seed-cavities. In this case are the forty-eight numbers of the wax beans that were under trial. As in the other holder, the numbers run from the first at the upper left-hand corner horizontally for each row until number 48 is reached, at the lower right-hand corner. The number for each kind does not show distinctly in the engraving. When the final adjustment is made, the name of each variety can be placed under its pocket.

Experiments With Peas.

A portion of plot 1, series VI, was devoted to experiments with peas. Through the kindness of Professor W. T. Macoun, of the Experimental Farms at Ottawa, Canada, seeds were obtained of four varieties of peas. The original peas of this lot were obtained of a New York seed house in 1896, and successive crops of these varieties had been grown by Professor Macoun at Ottawa each year since that date. These peas were sown in parallel rows with seed of the same sorts obtained direct from the same seed house that originally furnished the Canadian seed. The seed purchased from the New York house this spring was grown in Jefferson County, New York. The comparison was, therefore, between seed with its ancestory Canadian since 1896 and that from a more southern locality.

The seed was sown on April 26th; upon May 9th row 1 was more advanced than row 2. Row 3 was a little better than row

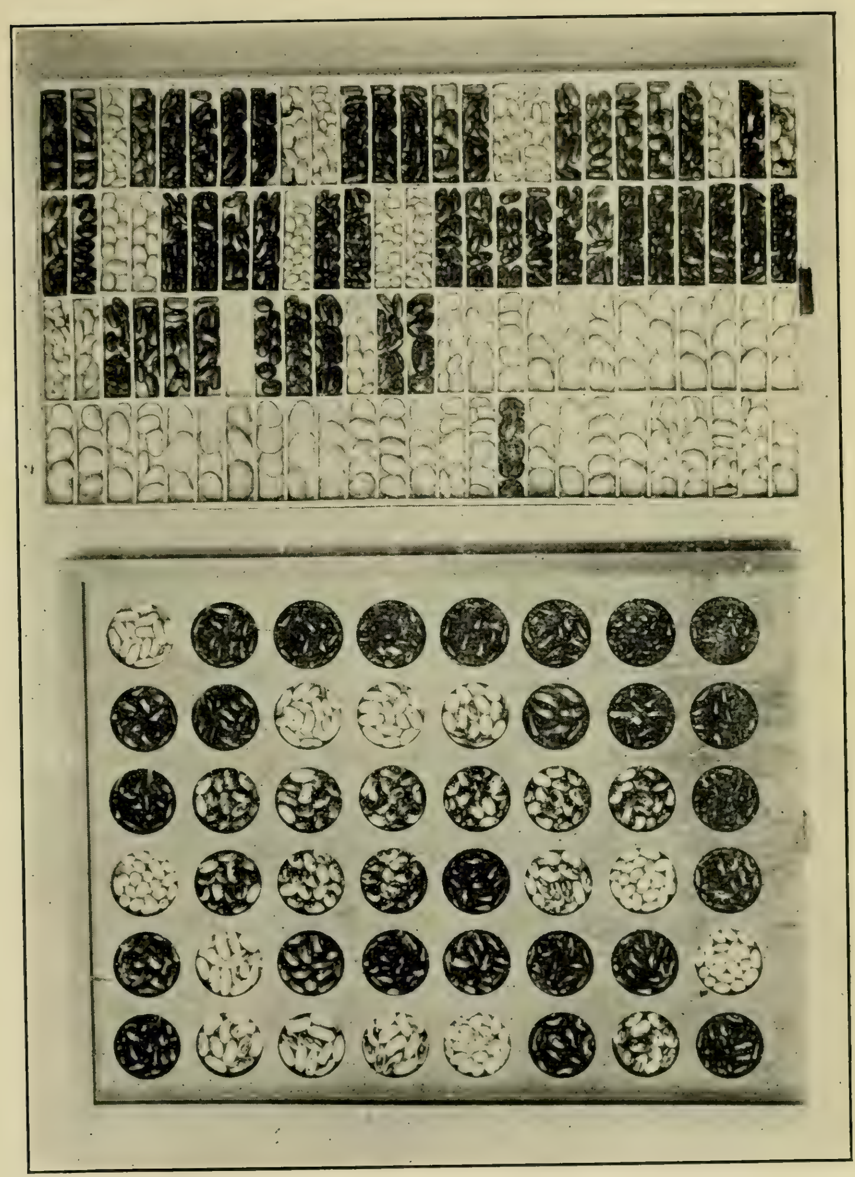

PLATE XI. Bean Holders. The upper case holds one hundred samples of green podde
bush and various sorts of Lima Beans. The lower case has
forty-eight numbers of Wax Beans

4, while row 6 was in advance of row 5. The same differences were observed on May 17th. Row 6 was the first to show bloom, which was on May 27th.

Upon June 14th the "Abundance" and "Alaska" were ready for picking. In the time of fruiting, maturing, etc., there was no material difference between the Canadian and New York "Abundance" plants. The New York "Alaska" seed gave somewhat larger vines. On the other hand, the New York "O'Rourke" seed produced the smaller plants.

The following table shows some of the facts recorded for a thirty-foot row of the three varieties:

NAME OF VARIETY.	Weight of vines.	Weight of pods.	No. of pods.	No. of Seeds.
"Abundance" Canada	2 6-8 lbs.	1 10-16 lbs.	356	1,486
" New York	3 11-16 "	1 15-16 "	616	2,416
"Alaska" Canada	1 ½ "	1 1-16 "	519	1,852
" New York	1 5-16 "	1 "	512	1,814
Daniel O'Rourke, Canada—weight not taken.				1,000
" " New York	1 3-16 "	1 3-16 "	514	1,410

Further Observations Upon Salsify Hybrids.

Plot III., series II., was sown last season to a mixture of seeds of a hybrid between the garden salsify (*Tragopogon porrifolius L.*) and the wild species (*T. pratensis L.*). The season's record for colors of the blooms, according to Prang's list, is as follows:

	No.		
	21	Darker red red orange	6
	22	Dark red red orange	4
	31	Darker red orange	37
	41	Darker orange red orange	28
	61	Darker orange yellow orange	9
	82	Dark yellow yellow orange	2
	92	Dark yellow	8
Parent type.	93	Yellow	28
	94	Light yellow	13
	95	Lighter yellow	7
	223	Violet red violet	4
Parent type.	224	Light violet red violet	10
	225	Lighter violet red violet	31
	233	Red violet	78
	234	Light red violet	86
	235	Lighter red violet	6
	242	Dark red red violet	50
	243	Red red violet	31
	253	Orange gray (brown)	5
	333	Lighter violet red violet	16
	334	Light red violet	1
	335	Lighter red gray (russet)	1
	354	Light yellow gray (citrine)	1
	355	Lighter yellow gray (citrine)	1

Salsify Hybrids left to Nature.

The second half of plot I, series VII, was sown with seed of hybrid salsify (*Tragopogon porrifolius L.* and *T. pratensis L.*) in the summer of 1900, and it has been left to self-seed the same area since that date. Upon June 4th of the present year the following record of colors was made:

	31	Darker red orange	4
	31	Darker red orange (center mottled)	4
	41	Darker orange red orange	2
	41	Dark orange yellow red orange (center yellow	5
	62	Dark orange yellow orange	1
	82	Dark yellow yellow ronage	1
	92	Dark yellow	4
	92	Dark yellow (center yellow)	1
Parent type.	93	Yellow	40
	94	Light yellow	4
	95	Lighter yellow	9
	223	Violet red violet	2
Parent type.	224	Light violet red violet	4
	224	Light violet red violet (center yellow)	1
	225	Lighter violet red violet	1
	233	Red violet	2
	234	Light red violet	5
	242	Dark red red violet	6
	243	Red red violet	4
	253	Orange gray (brown)	4
	254	Light orange (gray)	1
	355	Lighter yellow gray (citrine)	1

It is seen that of the 108 plants and 22 colors represented the plain yellow has much the largest percentage. This is the color of the wild parent, and suggests that the hybrids when left to themselves may drift back to the wild yellow type. However, much longer time is needed for any conclusion from this experiment.

Seeding Capacity of Various Colors.

The following table shows something of the seeding capacity of the various colors:

Color.	No. of heads.	No. of plump seeds.	Seeds per head.
21	9	56	6
31	3	65	22
93	13	350	27
225	4	40	10
233	3	120	40
234	3	85	28
242	2	41	20
243	8	62	8
254	9	150	17

Experiments With Lawn Grasses.

The nine plots seeded to grass, and serving as a border to the Experiment Area. have been kept cut with a lawn mower during each season since 1896. The following table gives the number of the plot, name of grass seed sown and the condition or stand, of each plot in percentage of perfection for each of the past nine years.

Plot.	1896.	1897.	1898.	1899.	1900.
1. Meadow Fescue (*Festuca pratensis* Huds.)	90	50	40	45	55
2. Fine-laeved Fescue (*Festuca tenuifolia* Sib.)	5	50	40	40	40
3. Sheep's Fescue (*Festuca ovina* L.)	10	50	40	40	30
4. Rhode Island Bent (*Agrostis canina* L.)	80	80	90	90	90
5. Wood Meadow (*Poa nemoralis* L.)	60	65	70	85	80
6. Kentucky Blue (*Poa pratensis* L.)	50	65	90	90	85
7. Rough Meadow (*Poa trivalis* L.)	90	65	70	70	45
8. Redtop (*Agrostis alba vulgaris* With.)	100	90	70	60	25
9. Perrennial Rye (*Lolium perenne* L.)	100	85	70	40	20

Plot.	1901.	1902.	1903.	1904.
1. Meadow Fescue (*Festuca pratensis* Huds.)	60	60	80	80
2. Fine-leaved Fescue (*Festuca tenuifolia* Sib.)	45	45	40	40
3. Sheep's Fescue (*Festuca ovina* L.)	25	40	40	40
4. Rhode Island Bent (*Agrostis canina* L.)	95	95	95	95
5. Wood Meadow (*Poa nemoralis* L.)	85	90	85	85
6. Kentucky Blue (*Poa pratensis* L.)	85	80	80	80
7. Rough Meadow (*Poa trivalis* L.)	70	60	50	50
8. Redtop (*Agrostis alba vulgaris* With.)	25	20	50	50
9. Perennial Rye (*Lolium perenne* L.)	15	15	40	40

The past season was a fine one for grass and all the plots did better than the previous year but the mixing in of other than the original species sown makes it difficult to change the figures and, therefore, they remain as for 1903. It would be necessary to let the grasses grow up to flowering condition to determine how far each species is responsible for the turf that is in each plot.

Experiments With Weeds.

The weed belt has been continued for eight years without the soil or its productions being interfered in any way. The following table shows the leading fourteen species for the past season. Those of the list that have been among the first fourteen in previous years have their rank shown under the year in which they were recorded:

Botanical Name.	Common Name	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
Aster paniculatus Lam. (?)	Aster	..	..	..	..	..	13	7	1
Ambrosia artemisiaefolia L.	Ragweed	3	5	1	1	14	12	13	2
Polygonium Pennsylvanicum L.	Smartweed	6	3	2	2	4	4	6	3
Mililotus alba Lam.	Sweet clover	..	..	..	12	10	10	4	4
Oxalis stricta L.	Oxalis	..	..	..	8	11	11	12	5
Rumex acetosella L.	Sorrel	..	7	4	3	1	1	1	6
Plantago Rugelii L.	Plantain	..	..	12	..	..	..	..	7
Abutilon Abutilon L.	Velvetleaf	7	2	6	6	3	5	11	8
Ixophorus glauca (L)	Foxtail grass	..	..	..	7	..	..	..	9
Coarse grass—not in bloom.		..	..	..	..	..	..	..	10
Daucus carota L.	Wild carrot	12	..	..	4	5	2	2	11
Barbarea Barbarea (L).	Yellow rocket	..	..	..	11	..	..	..	12
Bidens frondosa L.	Beggar's ticks	..	..	..	..	..	..	..	13
Acalypha Virginica L.	Mercury	..	..	..	..	..	..	..	14
Other conspicuous species of weeds were:									
Tragapogon pratensis L.	Salsify								
Arctium Lappa (L).	Burdock								
Sytherisma sanguinale (L).	Crabgrass								
Hibuscus Trionum L.	Ketmia								
Silene noctoflora L.	Catchfly								
Polygonum Convolvulus L.	Bindweed								

It is seen that four of the species that were in the first list (1897) are still among the first fourteen, and it is to be observed that the ragweed holds nearly the same rank this season as it did eight years before. It has been first on the list for two years, and in 1901 it was the last to get a record. It is also to be noted that a rank growing aster came in two years ago, and has gone rapidly to the first place. The sorrel, velvetleaf and wild carrot hold nearly the same place they did seven or eight years ago, while the grapevine this year has become so large and strong as to take a high rank. The cherry tree is growing apace, and will shortly have much influence upon its end of the area devoted to weeds.

Now is recorded for the first time a seedling peach tree that is quite certain in the natural course of things to cast a shadow over much that is enumerated above.

Experiments With Cauliflower.

Upon a very small scale a test was made of cauliflower seed of the same variety, "The Early Snowball," which was grown in widely separated regions. One packet was obtained from Denmark, through an American agent; a second lot was grown in the State of Washington, and sent from there by one who raised it. The third lot of seed is also American grown, but of a more Eastern source. The row given to plants from foreign seeds yielded two medium-sized heads, two small and four young heads. The Washington State row gave four medium, five small and four forming heads, while the more Eastern seed yielded one medium, two small and five forming heads. The Washington plants were the largest and most thrifty in every way, and, as shown above, produced more than both the other rows.

Aralia Cordata as a Salid Plant.

In the spring of 1903 seeds were sown of *Aralia cordata,* furnished by the U. S. Department of Agriculture, through the kindness of Mr. D. G. Fairchild. The plants grew thriftily, and at the close of the season one-half of them were covered with a heavy mulch. All the plants, both those protected, and the fully exposed ones, came through the winter without apparent injury. These plants have flourished the present season, growing as high as one's head and blossomed freely. At the close of the season, a considerable quantity of seed was gathered.

Thus far the plants in question have been studied only as to their hardiness and seeding capacity under garden culture. It is hoped that they may be investigated later as to their merits as salad plants.

Experiments With Tulips.

Last autumn a set of twenty tulip bulbs grown in Washington

State, and sent by the United States Department of Agriculture, through the courtesy of Professor A. J. Pieters, was planted in the gardens, and alongside of these bulbs a corresponding set obtained from a store in the city, and of foreign growth.

In the spring the winter protection of coarse manure was removed, and, when the bulbs had started into growth, it was determined that all of them were alive excepting one in the Washington set. Upon May 3d the first bloom appeared of a light red color, and in the Washington set. Upon May 5th there were three blooms in the Washington set and sixteen in the foreign lot. The following remark is taken from the record book: "Upon the whole, the 'market' (foreign) plants appear to be more vigorous than the 'Department' plants." Upon May 9th the record shows the Washington set with nine blooms, four of which were double, and the foreign lot with eighteen blooms, all single. Upon the 11th of May the record shows that "the tallest and finest blooms are among the Department plants." Upon May 12th, the Washington set had twelve and the foreign lot eighteen blooms, with three blasted buds in the latter set. Upon May 19th, the Washington set showed eight blooms and two buds, while the foreign lot had six flowers and no buds. Upon May 23d, twenty days after the first bloom appeared, there were but three plants in flower, and these were all in the Washington set.

It is seen that the American grown bulbs gave the finer flowers, and were longer in bloom than the foreign bulbs.

Notes Upon Nasturtiums.

At the outset it is interesting to note that the common name of the representatives of the genus Tropaeolum are called nasturtiums, which is the same name as the genus to which the water cress belongs. In other words, the generic name for the water cresses (*Nasturtium*) is applied as the common name of the garden nasturtiums (*Tropaeolum majus*), etc. The name nasturtium is an old Latin one, used by the Romans, and derived by Pliny from *nasus*, the nose, and *tortus*, twisted, "referring to the contortions of the nose caused by the hot acrid taste of the plants." The nasturtiums and the water cress, while in different families of plants, agree in this hot taste, and it is interesting that the name so vividly describing the characteristic above mentioned should be fixed upon the two groups of plants, the one in the scientific and the other in the common name.

During the present season there have been quite a number of nasturtiums bloom among our plants that show no spur; in other words, the flower is almost entirely regular in all its parts. This absence of the spur, together with a regularity of the calyx and corolla gives a bloom that in some respects suggests the Philadelphia lily, although the number of parts is not the same as in the latter flower.

This failure of the spur to develop is a case of the malformation which Linnaeus named as *Peloria*, a term from the Greek meaning prodigy. Linnaeus' example was, however, a toad flax, or "butter and eggs" (*Linaria vulgaris*) with five spurs instead of the one that is usually met with in this common weed. This malformation of the toad flax was a regular flower, resulting from the uniform development of the spur, and might well be termed a case of peloria—the irregularity, namely, the spur—normally in only one petal was present in all the petals. With the nasturtiums the flower, on the other hand, is regular by the failure of the calyx to develop any spur.

Masters, in his book upon "Vegetable Teratology," places the toad flax form under "Irregular Peloria" and the nasturtium under "Regular Peloria."

The latter form seems due to arrested development, or a reversion to the type that may have prevailed in the early history of the nasturtium flower before the spur had been formed for certain special advantages which it may secure in the process of pollination by means of insects.

Whatever may be the hidden cause of this regular monstrosity in the nasturtium, the result is a handsome flower that has some points of value to the gardener. For one thing, these blossoms can be picked with no danger of the spur becoming entangled in the leaves, and thus endangering a mutilation of the flower. While less grotesque or bazaar than the usual form, they have an exceptional dignity and grace. Attempts through breeding and selection are being made to perpetuate the regularity in question.

Report Blanks.

Through the courtesy of Professor L. C. Corbett, blanks provided by the United States Department of Agriculture have been received and filled out in duplicate, one set to be sent to Washington, while the other is placed on file in this office. These record sheets are upon stiff paper, size, six and a half by eight inches, and contains the items (for tomato) given in the sample below:

[Accession No.] [Subject.] **TOMATO** [Variety.] [Source.]

Location Section Plot Trial No.

Soil Clay. C. loam. Sand. S. loam. Silt loam. Gravel. Muck. Adobe. Lime. Slate. Rich. Naturally wet. Dry. Well drained.

Seed No. to oz. **Weather** Hot. Cold. Wet. Dry. **Development** Good. Poor. If poor, why? (Note A.)

Date Seed sown. Plants picked out. Set in open ground. When 5% marketable When 50% marketable. (See harvest record on back.)

Area No. of plants. Distance apart. **Yield** Market product. Large. Good quality. Estimated yield per acre. Amt. of green and unmarketable fruit.

Date and initial of observer

Plant, cherry type			**Fruit,** core long			**Flesh,** rich color			
" normal type			" basin distinct			" evenly ripened			
" potato-leaf type			" scar distinct			" many celled			
" Dwarf Champion type			" corrugated			" cell walls thick			
" natural spread			" sutures broad			" cell walls firm			
" avg. No. fruits in cluster			" sutures deep			" cell walls soft			
" healthy (Note B)			" color rich red			" cell walls coarse grained			
Leaf, large			" color purple red			" cells well filled with pulp			
" smooth			" color yellow			" pulp thick			
" deeply cut			" color light			" flavor mild			
" dark green			" color yellow dotted			" rich and fruity			
" yellow green			" color evenly developed			" flavor acid			
Fruit, globular			" skin cracked (surface)						
" flattened			" fissure crack (deep)						
" elongated			" avg. weight prime mark						
" cross sect. round			" contains many seeds						
" cross sect. oval			" firm, stands ship well						
" cavity deep			" long in edible cond.						
" cavity broad			" subject to rot						
" core large									

Practically the same as Seems a Good Stock of

The most like Distinct Desirable

Stock $ extra good. $ fair quality. $ off. $ mixture. Observer and initial

Similar blanks to the above have been filled out for sweet corn and beans, and in duplicate for the Bureau of Plant Industry. These sheets make a full record of the observations upon any variety of vegetable they are planned to include.

Fungi, Weather and the Crops.

The following items concerning crop plants are gathered from the "Weather and Crop Bulletin," issued weekly by the State Weather Service during the growing season:

April 12th—"Crimson clover mostly dead;" "Grain backward and much winter killed;" "Clover badly winter killed;" "Blackberries badly winter killed;" "Peaches badly killed;" "Peaches reported nearly all killed;" "Blackberries and raspberries killed."

April 19th—"Early sown wheat uneven, some turned black;" "Three-quarters of the peach buds winter killed;" "Crimson clover all dead;" "Crimson clover largely winter killed;" "Late sown clover winter killed;" "Crimson clover nearly all winter killed."

April 26th—"Blackberries and raspberries seem winter killed;" "Sweet potatoes are rotting in the hot-beds, the low temperature preventing planting in the fields;" "Peaches nearly all killed;" "Crimson clover killed by severe weather in March;" "Alfalfa killed in low places."

May 2d—"Peaches and raspberries winter killed;" "Crimson clover all winter killed;" "No peach buds alive;" "Raspberry and blackberry canes all killed;" "Crimson clover all killed."

May 10th—"Peach trees badly injured, young trees frozen to the ground and killed; most peach orchards here are dead;" "Raspberries winter killed;" "Blackberry and raspberry bushes injured by severe winter weather;" "Plum trees in exposed places have tops killed;" "Citron acreage will be reduced owing to blight."

May 17th—"Potatoes up, some rot reported;" "Some peach trees in bloom, but many winter killed."

May 24th—"Raspberries badly winter killed;" "Corn germinating slowly, and some rotting on heavy soil;" "Some pears dropping;" "Spraying for pear blight;" "Tomatoes wilty in places."

May 31st—"Corn coming up uneven; considerable seed rotting, and will be replanted;" "Many peach trees winter killed;" "Peach trees badly affected by the 'curl;'" "Cherries dropping badly."

June 6th—"Corn uneven; much seed rotted in the ground; considerable replanting must be done;" "Apples and pears dropping badly;" "Fruit dropping badly;" "Cherries dropping;" "The June drop has begun."

June 14th—"Apples dropping;" "Peaches and cherries dropping;" "Fruit of all kinds dropping freely;" "Cherries are rotting on the trees;" "Some apples and pears dropping;" "Early cherries decaying."

June 21st—"Apple, peach, pear and quince trees were greatly injured by the severe winter weather, also blackberry and raspberry bushes;" "Fruit dropping badly past two weeks;" "Apples and pears dropping;" "Bartlett pears are affected by blight."

June 28th—"Apples dropping;" "Plums dropping badly;" "Peach trees look bad;" "Apples and pears dropping."

July 5th—"White cherries rotted on the trees;" "Apples, drop light;" "Apples dropping."

July 12th—"Apples and pears dropping badly;" "Early peaches are rotting on trees;" "Some apple and pear trees affected by blight."

July 19th—"Apples dropping badly."

July 26th—"Apple trees showing leaf blight;" "Early grapes rotting slightly;" "Early plums rotting;" "Grapes in vicinity of Egg Harbor and Hammonton are not so promising, rot causing unusual damage; even the 'Ives' are affected;" "Apples dropping badly;" "Beans blighting."

Ausgust 2d—"Potatoes being dug, much scab noticed;" "Potatoes affected with scab;" "Plums rotting badly;" "Grapes rotting;" "Plums rotting badly;" "Grapes rotting;" 'Grapes are rotting badly."

August 9th—"Potatoes show some blight;" "Apple trees continue showing leaf blight;" "Potatoes showing some signs of blight;" "Potatoes, some blight noticed;" "Apple crop light and dropping badly;" "Potatoes rotting in low fields;" "Corn somewhat scalded;" "Grapes rotting badly;" "Potatoes begin to rot;" "Corn is scalding;" "Lima beans being injured by mildew;" "Grapes rotting badly.'

August 16th—"Potatoes show signs of rot;" "Pears are dropping badly;" "Potato crop in danger of total failure from rot;" "Plums rotting;" "Grapes rotting;" "Early and late tomato vines badly scalded, some late patches worthless;" "Apples dropping;" "Grapes rotting in some vineyards;" "Potatoes rotting;" "Potatoes and tomatoes rotting;" "Potato digging advancing rapidly; vines mostly dead;" "Considerable tomato leaves blighted;" "Corn scalded in places;" "Tomato and asparagus blight very prevalent;" "Potato rot not serious;" "Lima beans affected by mildew;" "Grapes rotting some;" "Mildew spreading rapidly over lima beans;" "Vines of late tomatoes badly blighting;" "Blight attacking melons, cucumbers, tomatoes and potatoes."

August 22d—"Corn on upland turning yellow;" "Potatoes promising, some blight;" "Potatoes good, only a little rot;" "Potato rot threatened;" "Heavy crop of plums; Japan varieties rotting badly;" "Grapes rotting;" "Grapes rotting;" "A little rot among early potatoes in low fields;" "Potatoes rotting;" "Winter apples are dropping badly;" "Lima beans molding;" "Potato rot not serious;" "Late tomatoes blighting some;" "Blight among citrons spreads slowly;" "Mildew on lima beans spreading;" "Tomato vines blighting."

August 30th—"Potatoes rotting in places;" "Considerable rot noticed in late potatoes;" "Potatoes are rotting in some fields;" "Potatoes rotting;" "Potatoes are rotting in heavy soils;" "Potato rot not serious;" "Apples are dropping from the trees;" "Lima beans molding badly;" "Considerable rot in potatoes reported;" "Late tomatoes and cabbage damaged by rust."

September 6th—"Some complaint of potato rot;" "Potatoes begin to rot;" "Lima beans molding;" "Potatoes rotting badly;" "Potato rot very bad;" "Potatoes rotting badly;" "Potatoes rotting badly;" "Potatoes rotting badly on heavy soils;" "Potatoes rotting badly;" "Corn scalded in places."

September 13th—"Potato digging progressing, some rot noticed;" "Potatoes, a little rot in some fields;" "Potatoes rotting badly in low fields;" "Apples dropping;" "Potatoes, some rot;" "Winter apples continue dropping;" "Potato rot serious;" "Potato digging progressing, some rot;" "Digging white potatoes; only a little rot;" "A little rot in potatoes;" "Cabbage rotting badly;" "Vine fruits and apples rotting badly."

The crops mentioned in the preceding notes are here arranged alphabetically, thus showing the number of times a given trouble is given. The numerals in parenthesis indicate the times the disease is reported upon that date.

Apples—July 26th, blight. August 9th, blight. September 13th, rotting.

Asparagus—August 16th, blight.

Cabbage—August 30th, rust.

Cucumber—August 16th, blight.

Citron—May 10th, blight.

Cherries—June 14th, rotting (2). July 5th, rotting.

Corn—May 24th, rotting. May 31st, rotting. August 9th, scald (2). August 16th, scald. September 6th, scald.

Grapes—July 26th, rotting (2). August 2d, rotting (3). August 9th, rotting (2). August 16th, rotting (4). August 22d, rotting (2). September 13th, rotting.

Lima Beans—July 26th, blight. August 9th, mildew. August 16th, mildew (2). August 22d, mold; mildew. August 30th, molding. September 6th, molding.

Melons—August 16th, blight.

Plums—July 26th, rotting. August 2d, rotting (3). August 16th, rotting. August 22d, rotting.

Potatoes—May 17th, rot. August 2d, scab (2). August 9th, blight (3); rotting (3). August 16th, rotting (7); blight (2). August 22d, blight; rotting (5). August 30th, rotting (7). September 6th, rotting (7). September 13th, rotting (8).

Peaches—July 12th, rotting.

Pears—June 21st, blight. July 12th, blight.

Sweet Potatoes—April, rotting in hot-beds.

Tomatoes—August 16th, scald; blight (3). August 22d, blighting (2). August 30th, rust.

It is seen that during April and the early part of May there are many mentions of injury to the crops due to the severe winter. Following this is the dropping of young apples, pears, plums and cherries, and then the rotting of those fruits and the blighting of the trees begin. The potatoes and lima beans suffered more than any other truck crops from rot and mildew, respectively.

The amount of complaint for the last three weeks, August 30th, September 6th and 13th, are less than for the corresponding weeks last year. In 1903 the number of mentions were: September 1st, potatoes, 13; tomatoes, 2; grapes, 1; lima beans, 1. September 8th, potatoes, 11; tomatoes, 4; grapes, 2; lima beans, 2; peaches, 1. September 15th, potatoes, 7; tomatoes, 5. In 1904—August 30th, potatoes, 7; tomatoes, 1; lima beans, 1. September 6th, potatoes, 7; lima beans, 1. September 13th, potatoes, 8; grapes, 1. In 1903 there were forty-nine reports of decay; injury to twenty-six for the present year. Upon the whole, it has been a season with a low average of injurious diseases.

Notes Upon Winter Injury to Plants.

In order to gather information upon the injuries sustained by plants in the State due to the severe winter of 1903-04, the following letter was sent out, through the kindness of Mr. E. W.

McGann, Director of the New Jersey State Weather Service, to each of his crop correspondents. An equal number, perhaps, of the same set of questions was mailed directly from the Experiment Station to the nurserymen and others of the State:

Dear Sir:—

As you well know, the winter recently closed has been one of great severity. It has been a "test winter," and on that account this office, co-operating with the Botanical Department of the Experiment Station, wishes to place on record any unusual effects that the past winter has had upon the vegetation of the State. To this end it is much desired that you will reply for your locality, to the following questions:

1. What forest trees or shrubs show signs of injury?
2. What orchard trees show signs of injury?
3. What small fruit plants show signs of injury?
4. What farm crop plants show signs of injury?
5. What garden crop plants show signs of injury?
6. What ornamental plants show signs of injury?

If you desire please write the reply in the space left below each question and return this sheet. A more extended answer upon a separate sheet will be thankfully received.

Yours very truly,
E. W. McGANN.

Sussex County.

This is the most northern county of the State and has the highest point of land within New Jersey. The reports from Sussex are few but they show that the temperature at times was very low during the past winter.

1. There are no reported injuries to forest trees and shrubs.

2. Upon the hills the older peach trees lacking vitality were injured. Young trees were unharmed. In the valleys the trees were sometimes badly frozen.

3. Blackberries were harmed somewhat.

4. Red Clover and timothy greatly injured and wheat and rye badly damaged.

6. Some rose bushes entirely killed; privet damaged; honeysuckles killed to the ground and catalapa trees frozen to the main branches.

Passaic County.

1. Maple, chestnut, and walnut trees somewhat injured.

2. Peach, plum, cherry and pear trees greatly harmed.

3. Raspberry, blackberry and grape canes suffered and weak strawberry plants were injured.

4. "Rye and grass on low ground," also wheat and clover.

5. Spinach, sprouts somewhat injured and "plants in hot beds sometimes a total loss."

6. "Old fashioned boxwood which was never known to be killed by any previous winter." Hollyhocks and roses badly injured, also retinosporas, Colorado blue spruce and young evergreens generally in the nursery rows.

Bergen County.

1. Locust elm crataegus and catalpa slightly injured.

2. All report harm to peaches and others mention that apple, pear, quinces, plums, and cherries were injured.

3. Blackberries, raspberries were harmed and one reports injury to strawberries.

4. Crimson clover was harmed.

5. Spinach, sprouts, leeks and parsley were injured.

6. Taxus baccata and Abies Nordmanniana, and boxwood in particular. "Mahonia was killed to six inches of the ground." Other ornamental plants that sustained injury are: Privet, strawberry shrub, Japan snowball, honeysuckle, forsythia, wegelia, deutzia, mock-orange and retinosporas.

Morris County.

One correpsondent remarks that: "The winter of 1874 was as cold as this past winter."

1. "Maple, beach, sassafras and chestnut slightly; dogwood, huckleberry and laurel more evidently injured."

2. "Quince trees upon the low lands were frozen." Peaches both in orchard and nursery. "Peaches in nursery in particular." "Old apple trees somewhat damaged.

3. Raspberries, blackberries, strawberries. "All small fruit plants more or less injured."

4. "Wheat suffered somewhat and clover in exposed places." "Wheat and rye." "Rye and wheat killed to a large extent."

6. "The part of the privet protected by the snow sprouted finely." "Honeysuckle died to the ground and many roses thought to be hardy have been killed." "Strawberry shrub, bridal wreath, and many kinds of roses." "Box, California privet, English ivy and honeysuckle." "The privet and boxwood hedges were badly frozen." "Evergreens were frozen badly including Norway spruce." "Rose bushes damaged fifty per cent." "Honeysuckle, sweet shrub, creeping ivy and trumpet creeper."

Warren County.

1. Maple.

2. Apple, quince, peach and apricot. "Peach trees in bad condition."

3. Raspberries and blackberries.

4. Wheat and rye. "Wheat in flat places badly frozen."

6. Boxwood, English ivy badly. Roses, honeysuckle, hydrangias. "All boxwood badly frozen."

Essex County.

1. Sweet Gum (Liquidamber) willow-leaved oak, catalpa and tulip. "Cedar trees have been killed by the cold winter."

2. Apple, quince and peach. "Peach trees damaged and some killed." "One and two year old peach trees injured but not killed."

3. Blackberries and raspberries. "Raspberries, but not badly."

5. Asparagus.

6. Cupressus, Nordmann's fir, deutzia, spiraea, calacanthus. "Some of most of the large growing shrubs." "All European hollies. Many rhododendrons and evergreens." "Box of all kinds suffered badly." "The tops of many hedges were killed and in some cases the whole shrub." "English ivy lost nearly all its foliage and the terminal branches were killed." "Hovey's Golden arbor vitae, wistaria, trumpet vine killed." "Privet hedges injured badly." "Hollyhocks digitalis and rose of Sharon nearly all killed."

Hudson County.

1. Shrubs "heeled in" were nearly all killed, one half way down to the roots."

6. Hollyhocks unprotected suffered badly.

Hunterdon County.

1. "Chestnut sprouts in isolated cases."

2. "Peaches affected most." "Nursery peaches injured but not seriously."

3. Currants and gooseberries. "Blackberries mostly killed."

4. "Wheat on northern exposure."

6. Boxwood. Osage orange hedge. "Honeysuckle half dead."

Union County.

1. "Gum, plain, hemlock, spruce and catalpa."

2. Peach, quince, cherry, apricot, nectarines, and some European and Japanese plums, also Japanese chestnuts." "Some apples, nearly all peaches, grape vines suffered considerably." "Raspberries and some varieties of grapes."

3. Currants and gooseberries injured and nearly all blackberries killed."

4. "Scarlet clover nearly all killed."

6. Viburnums, almost all conifers and boxwoods and broad leaved

evergreens have greatly suffered." English ivy and honeysuckle killed. "Retinosporas badly damaged; privet killed to ground; barberries, loniceras, clematis in variety are all badly hurt." Pyrus Japonica and Spiraea injured.

A nurseryman furnishes the following details. "The wood of the Nectarines, Japan and Spanish chestnuts, English walnuts, fringe, hop-tree, laburnum, sweet gum, althea, callicarpa, deutzia, honeysuckle, Japanese hydrangea, jasmine, purple leaved plum, spiraea, viburnum, box, holly, phyracanthus, yew, while a much longer list includes the injured. Another grower writes: "All evergreens have been hurt excepting the Colorado and Norway spruces and pines; many spiraeas and scarlet oaks and shrubs in variety too numerous to mention."

Somerset County.

1. Catalpa. English walnuts badly frozen.

2. Peach, pear, plum and cherry. "Peach trees of all ages badly damaged."

3. "Blackberry and raspberry canes entirely killed to snow line; currants badly hurt."

4. Wheat and rye and especially crimson clover. "Wheat and rye injured on clay land."

5. Spinach. "Lettuce in cold frames."

6. Boxwood, roses, California privet, spiraea. "Rose of Sharon almost killed to the ground." "Hybrid roses killed to the ground." "Forsythia, deutzia and spiraea killed.

Middlesex County.

1. English walnuts.
2. Peaches.
3. Blackberries.
6. California privet, box, English ivy, "Roses of all sorts."

A nurseryman furnishes the following detais. "The wood of the English walnut and paper mulberry were more injured last winter than I have seen before in perhaps half a century. Of apples and Japanese hybrid plums only one year trees were materially injured. Of these we find the following more or less killed back and the severity to varieties was in the order named. Apples; Roxberry russet, Ladies' sweet, R. I. Greening, Ben Davis and Golden sweet. Japan plums; Satsuma, Chebot.

Monmouth County.

1. Catalpa, oriental plane, Populus fastigiata and Carolina poplar. "Possibly the damage to peaches may be attributed in part to the winter."

2. Peach, plum, pears, apple. "Many young peach trees were killed." "Bark bursted on body of some bearing apple trees. Peach trees

suffered as much or more than other orchard trees. Young trees of apple, pear, and peach set last fall and this spring and also those of one year standing have suffered. Kieffer pears are partly killed."

3. Blackberries and raspberries. "Strawberries produced poorly and had many blasted berries"

4. Late sown wheat and rye. "Wheat and rye killed in spots."

5. "Clover in wheat and rye stubble on northern slopes or where exposed to north and west winds has much of it disappeared."

6. "California privet, some varieties of roses, spiraea and osage hedges were all badly killed." "California privet, Kerria Japanica, Cercis Canadensis, Lonicera fragrantissima, Deutzia crenita, Mahonia Japonica, Cytissus laburnum, Abies Nordmanniana, Taxodium distichum and Azalia amoena were injured.

A nurseryman wrote, "To my surprise evergreens were injured less than in many previous winters excepting varieties of English yew which were almost entirely destroyed. The reason the trees came through so well is that they went into winter in excellent condition, not suffering from drought in autumn. I might add that California privet largely planted in this part of the State as a hedge plant was killed quite badly.

Mercer County.

2. "Peaches and Japan plums." "Peach, apple and cherry." "Peach trees are the worst sufferers. They are black down to within a few inches of the ground." "Some pear and plum trees are hurt." "All young wood in quinces injured." Peaches weakened by 'Scale' killed." "The past winter has demonstrated the fact very plainly that it is very important to plant peach orchards on elevated, fully exposed ground, so that they can have perfect air drainage."

3. "Blackberry canes nearly all killed above one foot from ground, also the Japanese wineberry." Blackberries generally killed except "Eldorado" and "Wood."

4. "Crimson clover suffered worst; grown it for fifteen years and never had it so completely killed before."

5. Asparagus and rhubarb.

6. Budded roses have suffered severely. "Privet (California) one and two year old frozen nearly to the ground." "Holly, roses philadelphus, privet and box are the worst hurt and Irish junipers also."

Ocean County.

2. Peaches very much injured.

3. Blackberries to some extent.

6. English ivy killed outright in some instances; privet somewhat injured.

Burlington County.

1. "Hog blackberries by roadsides dead." "Dead white oaks noticed."

2. "Peaches badly killed." "Some grape vines and currant bushes injured."

3. "Strawberries in many places have failed." "Gooseberries not vigorous." " 'Early Harvest' blackberries all dead." "Crowns of strawberries injured." "Canes of blackberry and raspberry injured all through our section." "Dorchester blackberries and red currants injured."

4. "Crimson clover was killed very generally." "Wheat, rye and scarlet clover." "Scarlet clover was winter killed." "Much winter grain frozen out." "All late sowed grain hurt."

6. "All tender roses were killed to the ground." "Osage hedge with much dead wood." "Nordmann's Silver fir mock orange much hurt." "Evergreen box, English and Irish yew and magnolia grandiflora harmed."

Camden County.

3. "Blackberry and raspberry plants have suffered."

Gloucester County.

1. "Mulberry trees in exposed situations."

2. Apples, peaches, cherries, pears. "Peaches and Abundance plums." "Ends of pear limbs dead."

3. "Blackberries all killed." "Strawberries showed unusual weakness."

4. Crimson clover. "Rye injured to a large extent." "Wheat in places frozen out."

5. "Scullions were all killed." "Onion sets." "Spinach killed." "Frame plants came out stunted in many cases."

6. Roses generally injured, Forsythia, English ivy.

Salem County.

The only injury reported was done to crimson clover and "some rose bushes."

Atlantic County.

1. The native whortleberry bushes were injured—something heretofore unknown to me."

3. "Cranberries where uncovered."

4. "Clover and alfalfa."

"A few plants and shrubs fared hard, Baccharis nearly all winter

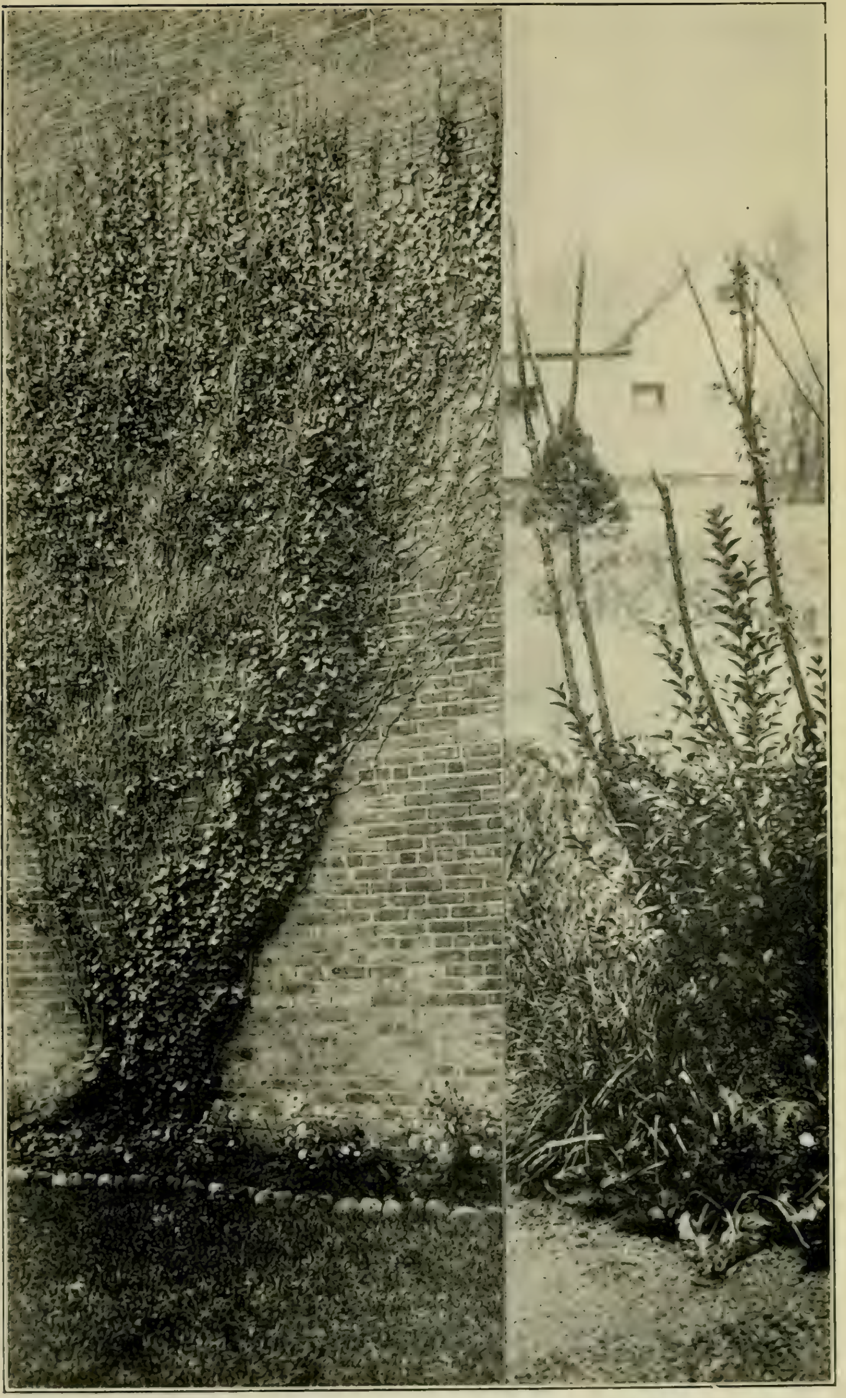

PLATE XII. An English Ivy, upon the left, that was nearly winter killed. On the right is a scarcely injured specimen of Californian Privet.

killed, and some small althaeas also. Lavender was thoroughly killed; not one plant out of hundreds escaped. Anchusa nearly all killed and digitalis where it had clean cultivation." Many of the roses were killed.

Cumberland County.

1. Walnut and maples.

2. "Peach and cherry trees in nursery were killed nearly to the ground."

3. Blackberry and raspberry plants badly injured and gooseberry bushes somewhat harmed." "Red raspberries were killed." "Strawberries did not blossom much."

4. "Crimson clover and all clovers." "Wheat, rye and grass."

5. "Spinach, winter onions, kale, salsify and seed onions."

6. "California privet and nearly all varieties of roses." "Roses and box hedges."

Cape May County.

2. "Jāpan plums have killed back."

"Peach trees show dead tips of branches." "Peach buds were frozen and dropped off before developing. Cherries have been hurt."

3. "Wilson blackberries froze to the ground." "Currant buds did not start this spring." "Some loss among gooseberries and strawberries."

4. Crimson clover was frozen out generally."

5. Spinach and onions were nearly all destroyed.

6. "Althaeas and roses killed nearly to the ground."

Plate XII gives samples of the injury of the past severe winter that were obtained close at hand. The English ivy is upon a brick wall of a house near the Experiment Station which offered favorable opportunity for a photograph. The wall and vine have a northeast exposure and it is seen to have been killed nearly to the ground excepting a single stem upon the right which developed locally a fair covering of new leaves during the past season the picture being taken on September 29th. It is to be observed that the old brown leaves upon the younger portions of the vine held on all through the summer. It remains to be seen whether the coming winter will further destroy the plant that was so badly injured.

The specimens of California privet is from the ornamental grounds at the College Farm—the dairy house being in the direct back ground. This was a single plant perhaps ten feet in height and of much beauty in 1903. After severe pruning the stubs did not develop leaves with any vigor and a new growth from the base will in time replace the former top unless it in turn is destroyed.

1. It is seen that the forest trees and shrubs have suffered slightly, among which were: Beach, catalpa, chestnut, dogwood, elm, hawthorn.

hemlock, huckleberry, laurel, locust, maple, mulberry, oak (willow-leaved), plane, poplar, sassafras, spruce, sweet gum, tulip tree and walnut. The catalpa, a southern tree, escaped from cultivation, has perhaps suffered the most.

2. Under orchard trees, the reports of injury are many, the peach, perhaps, leading all others. There are many indications that the scale helped on the destruction by weakening the various kinds of orchard trees that were destroyed.

3. Under small fruits the blackberries and raspberries suffered severely while currants, gooseberries and grapes did not escape. Some report injury to strawberry plants.

4. There was considerable loss of crimson clover and wheat and rye.

5. The garden crop plants suffered somewhat, and special mention was made of spinach, parsley, asparagus, onions and rhubarb. In many instances plants in cold frames were killed.

6. The injured ornamental plants make a long list, the boxwood and privet perhaps leading all others. The following are some of the sorts of plants that may be mentioned: Roses, English ivy, honeysuckle, deutzia, forsythia, snowball, spiraea, hollyhocks, digitalis, lavender and many spruces, young evergreens, Irish junipers and retinosporas.

Notes Upon Weather of Our Growing Season.

The growing season as herein considered embraces the half year made up of the months of April, May, June, July, August and September, that is, the middle six months of the calendar year. The figures used herewith are obtained from the Monthly Reports of the State Weather Bureau through the courtesy of its Director, Professor E. W. McGann.

Rainfall: Upon page 549 is a table showing the rainfall for the State for each month of the growing season for the past sixteen years, that is, covering the time that the writer has been connected with the Experiment Station. A glance at the column of averages to the right shows that the average of variation is within two inch, that is, 3.49 inches for April and 5.45 inches for July. The two warmest months, July and August, are the ones that lead in rainfall and the second half of the six months exceeds the first half by exactly four inches. The total for the season is 25.28 inches, which is practically a half of the total rainfall for the whole year. The total for each year shows a variation from 18.83 inches in 1895 to 36.87 in 1889, while the season of 1904 was very close to an average. The summers that have been wet often show a month of exceptional precipitation, as in 1889 July gave 10.19 inches or nearly double the average rainfall. The next year in rank of moisture shows a great rainfall in August of 9.43 inches, while the third in rank, 1897, has its July with the record of 11.42 inches against it, the largest for any month for the past sixteen years.

The dry and rainy seasons are somewhat in groups, that is, the first two taken together are decidedly wet ones followed by six that are all above the average for dryness while the last four seasons average high for rainfall. The rank which each season takes in wetness and dryness is shown in the lower lines of the table.

Temperature: In a table on page 550 corresponding to the one of rainfall it is seen that there has been some variation in temperature during the past sixteen growing seasons. In order to determine the relative temperature of a month it may be compared with the average for that month in the column at the extreme right. The warmest summer was in 1900 and the coldest in 1903, in fact the last three summers include the three coldest during the sixteen years while with one exception (1900) the three warmest came in succession in 1894-96.

By comparing the two tables, namely, that of rainfall and temperature, it is seen that the warmest summer was next to the lowest in rank of rainfall and the three successive seasons which were the coolest ranked 5th, 7th and 4th respectively in precipitation. That there is not a closer relation between warmth and dryness or coolness and moisture is due, for one thing, to heavy downpours of rain that may cover only short periods of time. For example the last three months of the season of 1889 were all above the average for rainfall and they were all below in temperature. The same thing is true of the corresponding months in the next (1890) season. In 1900 there was a shortage of rain in all months excepting one (May) and in that the amount above the average was slight. In this season the temperature was above the average for all the months excepting May, which was exactly the average. July of 1897, previously mentioned as leading all other months in rainfall, had a temperature a little above the average and is remarkable in that the showers were heavy and the warmth kept close to the normal for the month.

Sunshine: A third table (page 551) gives the sunshine for each month, the percentages being obtained by dividing the total of clear and partly cloudy days by the total number of days in the month. It is seen from the column of averages that August is the brightest month while April and May are the most overcast. Upon the whole summers are practically three-fourths (74.6 per cent.) fair weather. Some years have been more bright than others, as seen by the average for 1897 (80 per cent.) as compared with 1889 (61.5 per cent.) In the latter year the six months were below the average but the greatest lack was in July and September, which were the ones with heavy rainfall and low temperature. August and September of 1895 are the first ones in the table showing ninety per cent. of sunshine and these are both low in rainfall—not a half of the average amount, and with a record for high temperature. Nearer to the present time is the June of 1903, which gave the low record of 53 per cent. for sunshine and along with this it shows 7.68 inches of rain, over twice the average, and a temperature of 640° or 5.4° below the normal. Here is a clear case of a dark, rainy and cool month. The same thing is true of August of the same year, which shows sunshine only 65 per cent., rainfall 6.95 inches and temperature 68.4°, while May reverses the order and with sunshine 14.7° above the average, rainfall only 0.59 inch and temperature nearly two degrees above the normal. May was a bright dry, warm month, while the June, as shown above, that followed it, was exceptionally dark, rainy and cool. These contrasts that may come in adjoining months may bring a medium average to a season that is full of weekly or monthly extremes. In amount of sunshine the years 1898 and 1903 average the same (72.7 per cent.) but in rainfalls were 25.16 and 28.04 inches respectively and in temperature 65.9° and 64.0°.

These tables have been constructed with the hope of determining the relationship between weather and outbreaks of fungous diseases, a subject which may be presented later when more data are at hand. The season of 1904 has been close to the average in rainfall (7th) and sunshine (6th) but quite unusual in its record for low temperature. The reports of crop correspondents indicate that the injuries from rot, mildew, mold, etc., have been much less than during the previous season that ranked fourth in rainfall, first in coldness and fourth in darkness. It was a dark, rainy and very cool season and furnished conditions favoring the development of many kinds of fungous troubles.

Rainfall of the Growing Season for Past Sixteen Years.

	1899.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	§1898.	1899.	1900.	1901.	1902.	1903.	1904.	Average.
April	5.32	2.65	2.19	2.49	5.21	3.09	4.88	1.35	3.79	3.74	1.73	2.29	6.31	3.62	3.97	3.42	3.49
May	4.09	4.24	2.97	5.04	4.07	7.72	2.85	3.21	5.68	7.00	1.92	4.71	5.60	2.04	0.59	2.60	4.02
June	3.73	3.59	2.92	3.85	2.95	2.28	3.24	5.46	3.38	2.10	2.50	3.08	1.57	6.57	7.68	3.13	3.63
July	10.19	5.62	5.30	4.03	2.72	1.66	4.26	5.50	11.42	4.96	5.75	4.74	5.87	4.78	5.51	4.87	5.47
August	5.18	4.90	5.32	3.63	6.52	2.58	1.83	4.39	5.36	4.36	2.68	9.43	3.91	6.95	6.95	6.62	4.15
September	8.36	4.75	2.46	1.81	3.30	7.46	1.07	4.37	1.65	2.00	5.88	2.86	3.38	5.65	3.34	4.79	3.94
Totals	36.87	25.75	21.16	20.85	24.67	24.79	18.83	21.72	30.31	25.16	22.14	20.36	32.16	26.57	28.04	25.43	25.28
Average	6.14	4.30	3.53	3.47	4.11	4.13	3.14	3.62	5.05	4.19	3.69	3.39	5.36	4.43	4.67	4.27	4.25
Rank in wetness	1	6	13	14	10	9	16	12	3	8	11	15	2	5	4	7	....
Rank in dryness	16	11	4	3	7	8	1	5	14	9	6	2	14	12	13	10	....

Temperature of the Growing Season for the Past Sixteen Years.

	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	Average.
April	51.2	50.4	52.0	49.3	49.2	50.3	49.1	52.4	50.4	47.8	49.9	50.8	48.3	50.2	50.9	46.7	49.3
May	62.3	60.7	59.5	60.1	59.4	61.4	60.9	65.3	60.6	58.5	61.1	60.9	58.6	60.3	62.7	62.8	60.9
June	69.9	70.7	69.7	72.4	69.7	70.6	71.7	68.1	66.1	70.1	72.3	70.4	70.0	67.5	64.0	68.6	69.4
July	73.4	72.5	70.1	74.3	73.9	75.7	70.9	75.0	74.1	75.3	74.7	75.9	77.3	73.0	73.3	72.3	73.8
August	69.6	71.5	72.8	73.4	72.8	70.9	74.2	73.6	71.0	74.8	72.3	76.3	73.8	70.1	68.4	70.8	72.2
September	64.8	64.4	68.7	64.2	62.7	68.3	69.7	65.1	65.5	68.6	64.4	69.9	66.8	64.6	65.0	64.8	66.0
Average	65.2	65.0	65.4	65.6	64.6	66.2	66.1	66.6	64.6	65.9	65.8	67.4	65.8	64.3	64.0	64.3	65.3
Rank in warmth	10	11	9	8	12	3	4	2	13	5	6	1	7	14	16	15	....
Rank in coldness	7	6	8	9	5	14	13	15	4	12	11	16	10	3	1	2	....

Sunshine of the Growing Season for the Past Sixteen Years in Percentage of Clear-Partly-Cloudy Days.

	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	Av'ge.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
April	53	76	80	53	60	70	60	76	83	62	87	77	50	70	66	70	69.7
May	65	66	64	71	69	65	78	71	78	52	77	75	58	84	84	84	70.7
June	66	80	76	76	70	83	73	73	80	87	84	80	87	83	53	77	76.7
July	58	76	69	84	87	84	78	74	68	74	77	87	71	71	84	74	76.1
August	74	77	61	78	81	80	90	87	84	77	71	84	71	90	65	81	78.2
September	53	66	83	87	73	66	90	70	87	83	80	80	80	60	83	80	76.4
Average	61.5	73.5	72.2	78.2	73.3	74.7	78.2	75.2	80.0	72.7	79.3	78.9	69.5	76.3	72.7	77.7	74.6
Rank in brightness	16	10	14	4	11	9	5	8	1	12	2	3	15	7	13	6	....
Rank in darkness	1	7	3	13	6	8	12	9	16	5	15	14	2	10	4	11	....

List of Seedsmen Favoring the Station.

The following is a list of those from whom seeds have been received for the plantings of the present season and herewith the many courtesies that were extended, by all those who have aided in the work, are recognized with thanks. The abbreviation used throughout the report follows the name it represents.

Barteldes & Co., Denver, Colo., Btl.
Breck & Sons, Jos,, Boston, Mass., Brk.
Bruce & Co., John A., Hamilton, Can., Bru.
Childs, John Lewis, Floral Park, N. Y., Chl.
Cox Seed Co., San Francisco, Cal., Cox.
Currie Bros., Milwaukee, Wis., Cur.
Dreer, Henry A., Philadelphia, Pa., Drr.
Elliott & Sons, Wm., New York, N. Y., Elt.
Everitt, J. A., Indianapolis, Ind., Evr.
Ferry & Co., D. M., Detroit, Mich., Fer.
Farmer Seed Co., Fairbault, Minn., Fmr.
Farquhar & Co., R. and J., Boston, Mass., Fqr.
Gregory & Son, J. J. H., Marblehead, Mass., Ggy.
Hammond Seed Co., Harry N., Bay City, Mich., Ham.
Harris Co., Joseph Coldwater, N. Y., Hrs.
Henderson & Co., Peter, New York, N. Y., Hen.
Holmes Seed Co., Harrisburg, Pa., Hlm.
Iowa Seed Co., Des Moines, Iowa, Iow.
Jerrard Co., The G. W. P., Caribou, Me., Jer.
Johnson & Stokes, Philadelphia, Pa., J. & S.
Landreth & Sons, D., Bristol, Pa., Lan.
Livingston Seed Co., Columbus, Ohio, Liv.
Maule, Wm. Henry, Philadelphia, Pa., Mau.
May & Co., L. L., Minneapolis, Minn., May.
Northrup, King & Co., Minneapolis, Minn., NK.
Rawson & Co., W. W., Boston, Mass., Raw.
Salzer, John A., La Crosse, Wis., Sal.
Sioux City Seed Co., Sioux City, Iowa, Sox.
Thorburn & Co., J. M., New York, N. Y., Thr.
Vaughan's Seed Store, Chicago, Ill., Vau.
Vick's Sons, James, Rochester, N. Y., Vk.
Burpee & Co., W. A., Philadelphia. Pa., Bur.
Burrell, D. V., Rocky Ford, Colo.
Weeber & Don, New York, N. Y., W. & D.
Wood & Sons, T. W., Richmond, Va., Wd.

Special thanks are tendered to the following persons for various seeds furnished for the foregoing experiments:

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Prof. D. G. Fairchild, Washington, D. C.
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Mr. Samuel A. Gardner, Maplewood, N. J.
Prof. N. E. Hansen, Brookings, S. D.
Mr. D. W. Hess, Palmyra, N. J.
Mr. C. C. Hulsart, Matawan, N. J.
Prof. W. T. Macoun, Ottawa, Can.
Prof. W. F. Massey, Raleigh, N. C.
Prof. W. M. Munson, Orono, Me.
Mr. B. E. Musser, New Whatcom, Wash.
Prof. Wendell Paddock, Fort Collins, Col.
Prof. P. H. Rolfs, Miami, Fla.
Prof. W. W. Tracy, Washington, D. C.

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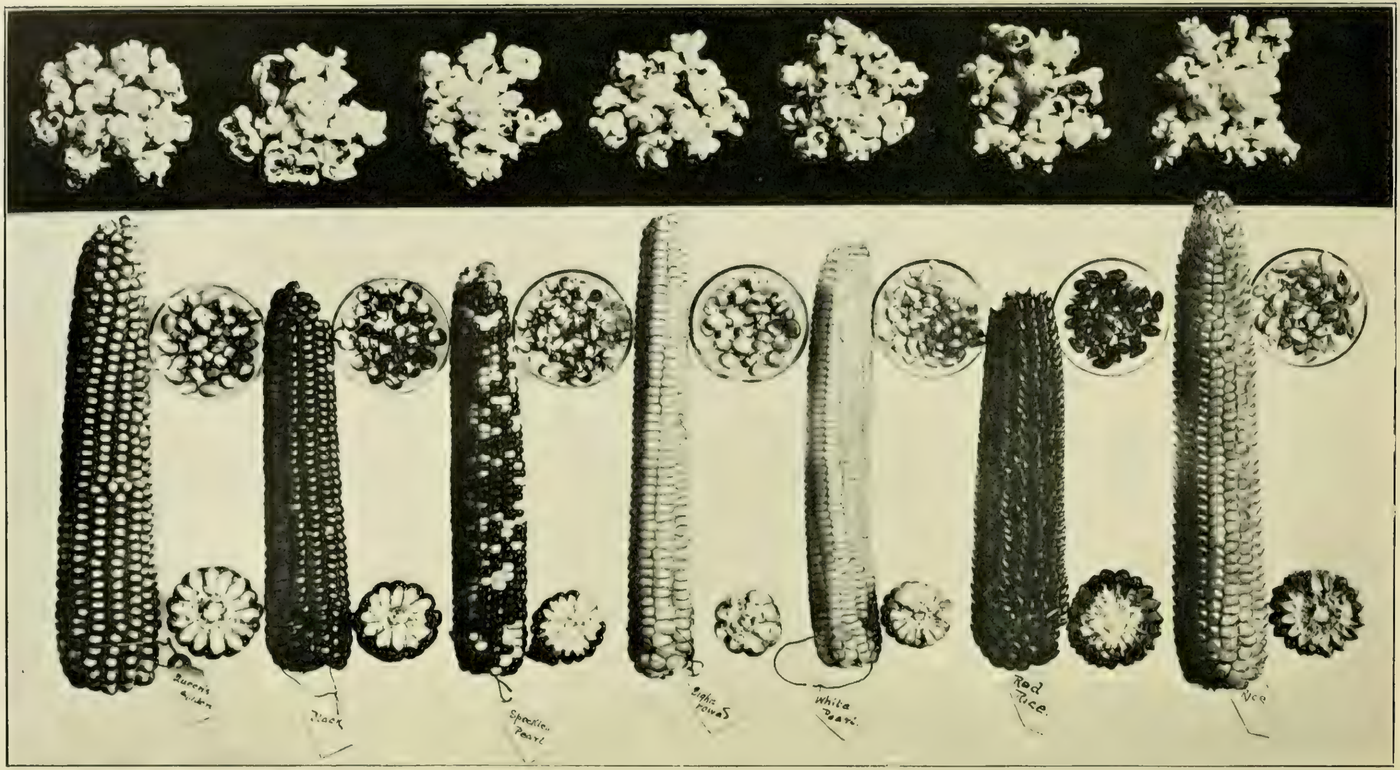

Queen's Golden
Black
Speckled Pearl
Eight rowed
White Pearl
Red Rice
Rice

PLATE IV.

Seven kinds of Popcorn, showing (1) ear, (2) section of ear and shelled corn, and (3) the popped grains of each sort.

popped grains of the two are scarcely distinguishable unless one looks carefully for the pointed tip which, when the grain is fully exploded, is lost from sight. The limited experience of a single season is not sufficient to judgeaof the yield in the eastern climate, but both are productive. The "Red Rice," while very attractive as ears in the market, is objectionable in that the popped grains are strongly marked with the hull, the red color of which does not disappear under the influence of the fire while being popped. Again, so many of the ears are white that a crop is a mixed one. Quite unlike the "Speckled," the two kinds of grains are never found in our experience upon the same ear.

In Plate IV. the upper portion, with black background, shows piles of popped corn, each representing the kind that is given just below in the ear and shelled, but the cream color of the "Queen's Golden" and other details quickly noted in the specimens themselves are lost from sight.

EXPERIMENTS WITH TOMATOES.

Old Varieties Grown the Present Season.

The following sorts of tomatoes were grown the present year from seed obtained in the open market, the source of each variety being indicated by the official contraction of the name of the seedhouse furnishing it. These were grown chiefly for the sake of comparison with the crosses that had been secured the previous year from plants grown from the same packets, and therefore all of the seeds in this list were purchased in the spring of 1904. It may be stated in passing that, with one or two exceptions, the seeds produced plants of normal vigor. A second reason for the growing of the old set was that a number of much-desired crosses might be made the present season. Time was not taken in making any study of the comparative value of the varieties. They, however, did not vary essentially from the record of the previous year, excepting in that the yield was materially larger, due to the season. No frost came this year to cut the vines until October 29th, which was nearly a month later than during the previous season.

1. "Acme," Btl.
2. "Acme," Liv.
4. "Arcadia," Jer.
6. "Atlantic Prize," Btl.
8. "Beauty," Btl.
10. "Belmont," Brk.
11. "Bermuda," Lan.
12. "Best of All," Drr.
13. "Brandywine," J. & S.
14. "Bright and Early," Vk.
15. "Brinton's Best," J. & S.
17. "Buckeye State," Fer.
21. "Climbing," Chl.
26. "Crimson Cushion," Hen.
27. "Crimson Whirlwind," Sal.
28. "Cumberland," J. & S.
29. "Dominion Day," Bru.
30. "Democrat," Thr.
32. "Duke of York," Rolfs.
33. "Earliana," Bru.
34. "Earliana," Fer.
36. "Earliana," Hulsart.
37. "Earliana," Rolfs.
42. "Early Ruby," Liv.
44. "Enormous," Hrs.
48. "Favorite," Liv., Btl.
49. "Favorite," Trucker, Bur.
53. "Fortune," J. & S.
54. "Freedom," Hen.
55. "Frogmore," Drr.
56. "Giant," Evr.
57. "Giant Climbing," Evr.
58. "Grandus," Liv.
60. "Honor Bright," Brk.
62. "Ignotum," Hlm.
63. "Imperial," Drr.
64. "King Humbert," Drr.
65. "King of the Earlies," Rolfs.
66. "Jewel," Bur.
67. "La Crosse Seedling," Sal.
69. "Liberty Bell," J. & S.
71. "Lorillard," Elt.
72. "Magnificent," Mau.
75. "Magnus," Ggy.
77. "Marvel," Drr.
81. "Matchless," Rolfs.
83. "Mayflower," Drr.
84. "Melrose," Hlm.
85. "Michigan," Fer.
87. "Minnesota," Ggy.
90. "Mikado," Evr.
93. "New Jersey," Thr.
94. "Nolte's Earliest," Fer.
96. "Novelty," Thr.
98. "Paragon," Liv.
99. "Perfection," Btl.
101. "Picture Rock," Chi.
102. "Pink," Hulsart.
103. "Ponderosa," Hen.
104. "Potato Leaf," Liv.
107. "Prizetaker," Hlm.
109. "Princess," Liv.
110. "Quicksure," Iow.
115. "Royal Red," Btl.
118. "Shipper's Choice," Ham.
121. "Stone," Btl.
122. "Stone," Hulsart.
123. "Stone," Liv.
124. "Stone," Rolfs.
125. "Success," Bur.
128. "Sutton's Best of All," Thr.
135. "Tree, Giant," Sal.
136. "Trophy," Drr.
137. "T. T. T.," Lan.
139. "Volunteer," Liv.
141. "Wonder," Elt.
143. "1903," Thr.
144. "Golden Queen," Btl.
145. "Golden Queen," Liv.
147. "Lemon Blush," Thr.
148. "Yellow Prince," Liv.
149. "Aristocrat," Farm.
150. "Aristocrat," (?) Hlm.
151. "Aristocrat," Liv.
152. "Aristocrat," Vau.
153. "Champion," Btl.
154. "Champion," Brk.
156. "Champion Scarlet," Brk.
158. "Dandy Dwarf," Liv.
159. "Extra Early Tree," May.
161. "Kansas Standard," Btl.
169. "Dwarf Stone," Hulsart.
170. "Dwarf Stone," Liv.
172. "Gold Ball," Liv.
173. "Golden Fig," Chi.
174. "Golden Nugget," Iow.
175. "Ivory Ball," Lan.
176. "Red Cherry," Thr.
177. "Red Currant," Thr.
178. "Red Peach," Thr.
179. "Red Pear," Thr.
180. "Red Plum," Thr.
181. "Sumatra Fig," Sal.
183. "Yellow Cherry," Thr.
185. "Yellow Pear," Thr.
186. "Yellow Peach," Liv.
187. "Yellow Plum," Thr.

REPORT OF THE BOTANIST.

REPORT OF THE BOTANIST.

BYRON D. HALSTED, SC.D.
EARLE J. OWEN, B.S., AND JACOB K. SHAW, B.S.,* ASSISTANTS.

The work in the Botanical Department for the year ending November 30th, 1905, has been in large part a continuation of the experiments in plant breeding as outlined in the report for the last few years.

The work with sweet corn has consisted in the development of the cross of the "Black Mexican" with the "Country Gentleman," four plots of the home grounds being devoted to this, namely, one planted with dark grains and another with white grains of the reciprocal crosses. Four blocks of ground were also assigned to crosses of the "Mexican" upon "Banana," "Garwood," "Malakhov" and "Striped Evergreen," respectively. Upon two other plots the "Malakhov" was bred upon "Crosby" and "Premo," respectively.

Outside of the Experiment area and upon land obtained from the Farm Department a full list of the white sorts of sweet corn was bred to three other kinds of corn, namely (1) a Black Pop, (2) a white flint ("Adam's Extra Early") and (3) a yellow sweet corn ("Golden Bantam").

A new feature of the year was the growing of a set of popcorns for a study of the varieties and some preliminary crossing with the hope of improvements.

The additional ground, nearly an acre, in widely-separated strips, permitted of a block of "Stowell's Evergreen" sweet corn for the Bureau of Chemistry of the United States Department of Agriculture, and also of some crossing work with squashes of both the summer and winter sorts.

Upon the Gardens proper were grown a set of thirty-five crosses of the summer squashes and several of the winter sorts. Three kinds were from seeds freshly imported from Japan, crosses of which with the American sorts were obtained in considerable numbers.

A full list of the eggplants was grown and several crosses obtained in addition to the block of "Jersey Belle" variety, which gave a supply of seed for distribution. Two other crosses of special worth were further developed. A hybrid between the "Scarlet Chinese" and the ordinary eggplant was fruited.

---

* Resigned in August.

A long list of new crosses of bush beans of both the green pod and wax sorts was grown for their first and second generations, and some progress was made in the selection of the bush lima beans.

A large portion of the Gardens was occupied with the new crosses of tomatoes, some of which are full of promise. From blocks of certain former crosses a good supply of seed has been saved for distribution. Of these is a cross between "Ponderosa" and "Magnus," the "Magnerosa." In addition to this a long list of the best sorts was grown and also a number of the novelties of the year. A fresh supply of seed of the "Station Yellow" tomato has been grown for further distribution.

The experiments with hybrid salsify have been continued and some results were obtained from the breeding of ornamental plants.

Bulletin No. 179, "Free Distribution of Experiment Station Seeds," of twenty pages and four page-plates, was published December 29th. As a result seed packets to the number of 872 were sent out, chiefly to the crop-growers of the State. This does not include the large number of samples of crossed seeds that were placed in the hands of scores of truckers and others for special tests, reports upon which cannot be given for another year.

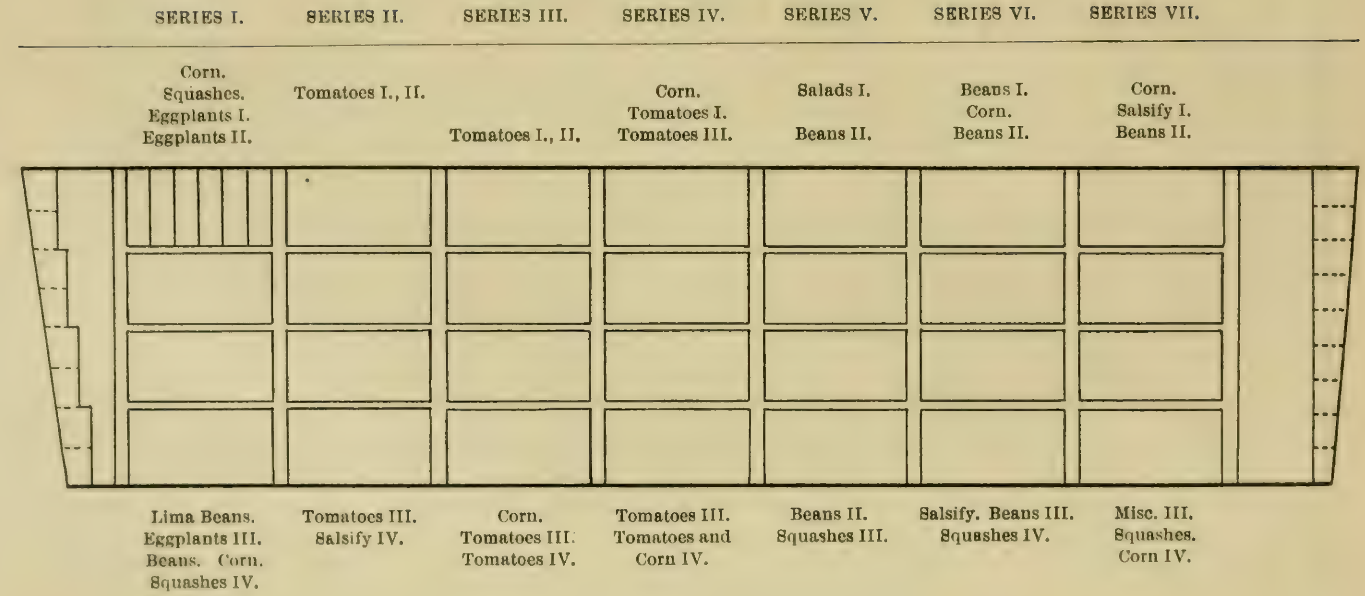
The work with the beans, eggplants and summer squashes has been in immediate charge of Mr. E. J. Owens, and that of tomatoes and winter squashes of Mr. J. K. Shaw, up to the time of his resignation.

THE EXPERIMENT AREA, OR GARDENS.

The plan of the Gardens is given upon the adjoining page. They consist of two acres, divided into seven series, with four plots to each series. Paths, in sod, four feet wide separate the series, while two-foot walks run lengthwise of the grounds and divide the plots. There are twenty-eight plots, each thirty-three by sixty-six feet, each a twentieth of an acre, to which is added an irregular block of ground at each end of the regular set of plots, as shown in the plan.

The soil is fairly uniform in quality, it being a mixture of clay and gravel, and at the outset was not of the best for garden purposes. Its texture has, however, been much improved by the annual application of stable manure, at the rate of twenty tons per acre, for the past eleven years. A small amount of commercial fertilizer has been used, for the first time the present season, where a second crop, as of beans or squashes, has been grown.

The Experiment Area for 1905.


SERIES I.
SERIES II.
SERIES III.
SERIES IV.
SERIES V.
SERIES VI.
SERIES VII.
Corn.
Squashes.
Eggplants I.
Eggplants II.
Tomatoes I., II.
Tomatoes I., II.
Corn.
Tomatoes I.
Tomatoes III.
Salads I.
Beans II.
Beans I.
Corn.
Beans II.
Corn.
Salsify I.
Beans II.
Lima Beans.
Eggplants III.
Beans. Corn.
Squashes IV.
Tomatoes III.
Salsify IV.
Corn.
Tomatoes III.
Tomatoes IV.
Tomatoes III.
Tomatoes and
Corn IV.
Beans II.
Squashes III.
Salsify. Beans III.
Squashes IV.
Misc. III.
Squashes.
Corn IV.

SWEET CORN UPON THE HOME GROUNDS.

Space upon the two acres in the Experiment Area did not permit of more than ten blocks of sweet corn, and with these early and late sorts needed to be so adjusted that as wide an interval as possible might be between any that bloomed at the same time. The first to be planted were the two breeding blocks, the one of "Malakhov" upon "Premo" and the other "Malakhov" upon "Crosby." The "Malakhov" has shown itself, in our climate, to be a very early sort of superior quality, but too small to be of much market value, and attempts have been made to increase its productiveness by uniting it with other sorts of recognized merit in productiveness. The "Malakhov," with us, carried ears ready for cooking by the 10th of July, while the "Premo," planted in alternate rows with it, was five days later. There is a much greater difference in the time of maturing the grain. A second planting with seed of this season's growing was made of the "Malakhov" upon August 1st, at which time the "Premo" was scarcely out of the milk. This second crop gave good roasting ears.

It may be said that the difference in time of blooming did not materially affect the securing of the cross because all of the earlier ears of the "Premo"—the ones most desired—were in season for the pollen of the largest stalks of the "Malakhov."

To anyone wishing to try his hand in breeding corn, it may be written that the work of breeding one sort upon another is very simple, provided that the blooming period is common to both and the tassels are all removed from the stalks of the female parent of the desired cross. This last requires attention at least once a day, and the tassels may be pulled when they are just emerging from the coil of leaves by grasping the young stalk well down with thumb and finger and giving a twist as the tassel is lifted. These tassels should be removed from the field, and it is a satisfactory practice all around to turn them over to a pet horse or cow for their enjoyment and digestion.

The bane of the breeder of corn, when the alternate-row and detasseling method is practiced, is the "sucker." It comes like a thief in the night, and before the tyro is aware its pollen has been spread by the morning breezes and done its work beyond repair. There is no safe rule with "suckers" save that of intolerance. They must be removed from the hills while they are still small, during any of the early hoeings of the breeding block, and from all the hills, whether of the proposed male or female parent of the cross. It is ear capacity, and not fodder tendency, that one is after in breeding sweet or table corn.

The ears of "Premo" thus secured all carry crossed grains, that the following season may be expected to produce corn that, in size of stalk and ear and earliness and sweetness of grain, will be a mean between these qualities in the parents. In this instance the stalk will be of fair height, the ear of good size—sometimes eight-rowed, like the male parent, and often more like the seed parent. The quality should be satisfactory and the productiveness good for such an early corn. A small block of this cross will be grown upon the home grounds for testing and selection to a type, but the main portion is available to those who may wish to test it under certain restrictions that may be imposed when the seed is distributed.

The second breeding block for corn was occupied with alternate rows of "Malakhov" and "Crosby" distantly situated from all other blocks of corn then in bloom. In fact, these two blocks above mentioned had the only ears in bloom at the same time, and only the "Malakhov" in these were permitted to produce pollen, and therefore the cross is practically pure.

In the case of the "Crosby" block the difference in time of blooming was fully a week—that is, the silks of the "Malakhov" were ready for pollen seven days before those of the "Crosby" were mature. However, many of the stalks of "Malakhov" produced tassels late enough to impregnate the "Crosby," save in case only of a few very slow-growing stalks that were by their delay fortunately eliminated, because the breeding was for earliness, in connection with the superior qualities of the "Crosby."

The seed thus secured is for free distribution to those who are willing to take the pains to isolate the plants from all other kinds of corn, and enjoy the added interest of having a new sort of sweet corn form under their care. In the present instance certain stalks were marked with wire labels when they were in silk, and this may be taken as a suggestion that the selecting of the ears for seed should be made early in the maturity of the plant. To use the best for the table is a poor rule when one looks ahead to future years. It requires but a little for planting, and by all means let that little be the best in every way. Favor the marked plants by removing the others from the hill. Select and then give the selected specimens the best opportunity for growth.

The "Black Mexican-Country Gentleman" Crosses.

Four blocks upon the Home Grounds were devoted to the crosses between the "Mexican" and "Gentleman" crosses of sweet corn. There were two in which the cross was with the "Mexican" as the male parent, namely, one planted with the black grains in this cross and the other with the white grains. Thus, by referring to the report for last year (1904) it is seen that of this cross—first generation—practically three-fourths of the grains upon any ear were dark and the remaining ones white. This is in accord with the law in breeding that was discovered by Mendel, and bears his name.

The two plots, while planted upon the same day, and so far as possible receiving like treatment, were not alike in soil and situation, being upon opposite sides of the trial grounds, and therefore the plants themselves were not strictly comparable. One block was upon land that was much better able to bear the long dry spell than another.

"Mexican" upon "Gentleman" (Black Seed Grains).

The crop from the dark grains of the above cross ("Mexican" upon "Gentleman") ($\frac{99}{19}$) is quite uniform, as is shown in the group of six ears in the upper left-hand corner of Plate I. There were many eight-rowed ears and several of them were solid black—that is, carried no white grains—while others were ten and twelve-rowed, made up entirely of black grains, as shown in the ear at the left of the set of six. There were no ears of strictly the "Country Gentleman" type, but several had the grains zigzag throughout the upper half. The ear at the extreme right of the set is a fair representative of the exceptional type in question. A solid black ear, showing strongly the "Gentleman" blood, is to be seen at No. 4. The three ears to the left favor the "Mexican," and the three to the right the "Gentleman" type. The amount of white grains is fairly well represented in the plate, for those thus marked have more than the average, while two—that is, No. 1 and No. 4—are solid black. A count of the grains from ten representative ears gave 3,095 black and 611 white grains, which is not far from the theoretical numbers for the third generation, when the colors obey the Mendel law of heredity, there being 83.57 per cent. black and 16.43 per cent. white.

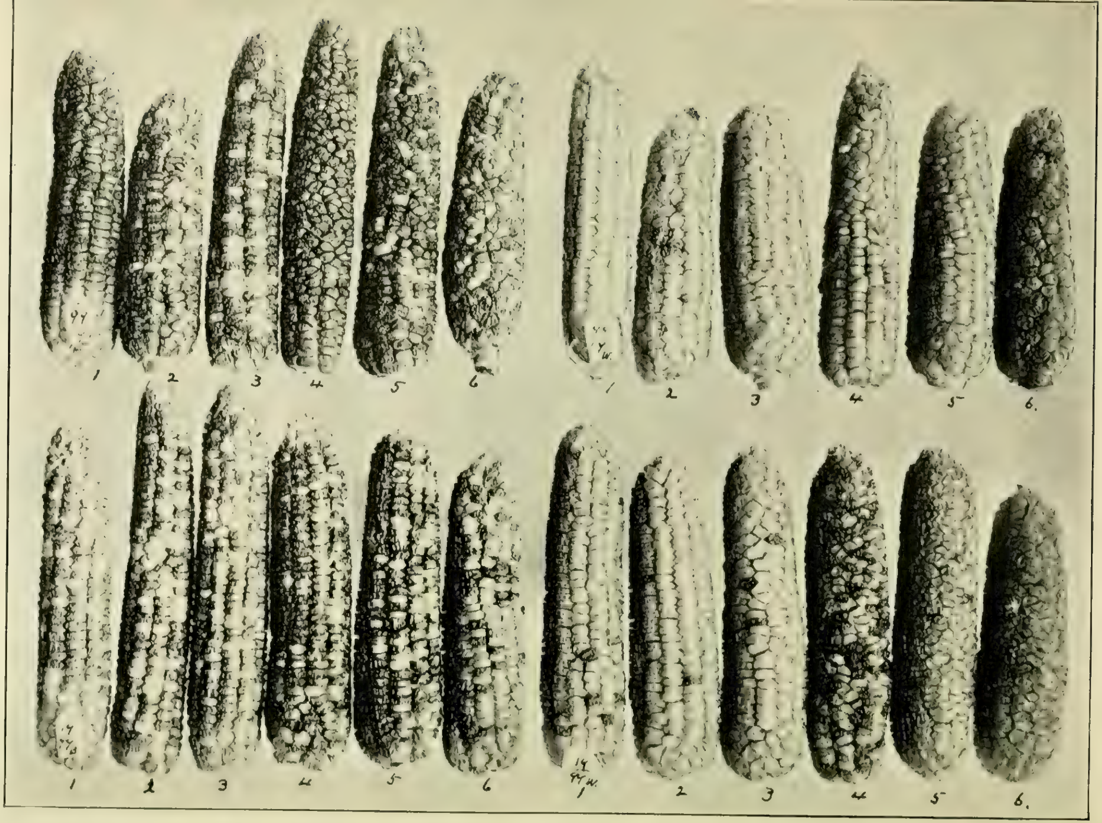


PLATE I.

Four sets of six ears each, representing the third generation of "Black Mexican-Country Gentleman" sweet corn. The first six (upper left corner) are "Mexican" upon "Gentleman" from black grains. The second (upper right), the same cross as last but from white grains. The third is "Gentleman" upon "Mexican" from dark grains; and fourth, the same cross as last but from white grains.

It should be stated that this crossed corn is entirely unlike the "Voorhees Red," made in a similar way of breeding the "Mexican" upon the "Egyptian," another white sort. In the present case the color of the dark grains is as black as those of the true "Mexican," and as a result the final cross, when the white grains are all eliminated, will be doubtless an ear with black grains, but, of course, having a blending of many other qualities of the two parents. Just why the result is not a red here, as with the "Voorhees," it is left for further experiments to decide.

It seems possible, by further selection and breeding from the crosses here shown, to obtain a variety that has the rows of a well-defined number and another of the true zigzag type of the "Gentleman"—that is, black grains from the solid black ear No. 1 might perpetuate its type, while those from No. 6, it would be expected, will produce the peculiar flattened and slightly curved ear of the "Gentleman" with the grains numerous long and disposed without order.

"Mexican" upon "Gentleman" (White Seed Grains).

The group of six ears in the upper right-hand corner of Plate I. illustrates the results obtained from planting a separate breeding block with the white grains obtained from an ear of the above cross as grown the previous season. The land where this lot of corn was raised was not quite as good as that of the corresponding black set, and on account of the very dry weather the ears are doubtless much inferior to what they would otherwise have been. The whole lot of a hundred or so of ears is practically white throughout, with the exception of two small ears that show perhaps one-quarter of black, suggesting that the grains planted carried the black quality, but so obscured as to escape detection at the time of planting. As in the previous group, the left three show the rows of grains distinctly, and they approach more nearly the form and arrangement of the grains in the "Mexican" than the three upon the right. The only ear that had the grains placed zigzag throughout is shown at the extreme right. It is seen that from ear No. 1 to No. 6 there is a somewhat similar set of variations as shown in the companion set, but here the grains are practically all white, and no further work is needed to get the color uniform. Here, again, there is hope of obtaining two types of ears by selection and breeding. It remains to be seen whether a white "Mexican," so far as the ear is concerned, can be procured, with all the sweetness of the famous dark variety, without its chief objection, namely, the black color.

"Gentleman" upon "Mexican" (Black Seed Grains).

In the lower left-hand corner of Plate I. is shown a set of six ears selected from the crop resulting from the planting of the dark grains' "Gentleman" upon "Mexican" ($\frac{19}{99}$) of the previous year. The half-bushel and more of ears are quite uniform, all having the black predominating and all adhering quite closely to the "Mexican" type—that is, there were no ears that had the grains placed zigzag, as in the "Gentleman." It is worthy of remark that the "Mexican" has impressed itself so thoroughly upon the cross, and were it not for the large, stout ear, with usually ten to twelve rows, and, of course, the many white grains, there would be very little to suggest the "Gentleman" parent.

It may be well to dwell for a moment upon the history of the black grains that have given this season the ears that are in question. In 1903 white grains were obtained upon "Mexican" ears that were grown close to the "Gentleman." Ears with these white grains are shown in Plate II. of the report for 1903. These white grains, when grown in a block by themselves, gave ears last year that were nearly solid white, as shown in Plate I. of the report for 1904. It is these dark grains that have produced the ears in question. It is possible that the dark grains of a year ago were from "Mexican" pollen outside of the block—that is, from the block planted with dark "Mexican-Gentleman" grains—and that the result of the present season is one of a secondary cross and might be expected to give ears with three-fourths of black grains. A count of ten typical ears shows the number of the two colors of grains as follows: Black, 2,398; white, 1,098—or 68.59 per cent. and 31.41 per cent., respectively. It seems evident that there was white "blood" in the dark grains used for seed.

"Gentleman" upon "Mexican" (White Seed Grains).

By far the most satisfactory block of the four in this set of double reciprocal crosses i the one from which the set of ears is shown in the lower right-hand corner of Plate I. Considering the unfavorable season the yield was fine, and the bushel of ears are of two leading types, namely, those with the rows distinct and those having the grains placed zigzag. The three ears to the left show the former characteristic, while the other three are manifestly "Gentleman" in type. Several of the ears show solid white grains and none of them show more than the few in five of the ears in the set in question, excepting six, which were strongly marked with black, as shown in ear No. 4 in the set. The explanation for this seems to be that these ears came from grains that carried the "Mexican" blood, but so obscured as to escape detection at the time when the grains were selected for seed. If this be true, it is reasonable to presume that all the dark grains in the whole block came from these few sources of contamination. Had the seed grains all been truly white, it is safe to predict that the whole block would have been white and the variety established, so far as the color of the grains is concerned. A count of the grains upon an average of the mixed ears showed 220 black and 210 white grains. If the seed planted was half white and half black, it follows, owing to the dominant quality of the black color in mixed grains, that it would require that all the pollen of the whole block of stalks should be of pure white blood to bring the ear in question to a mixture of half and half. The small percentage of mixed stalks that produced mixed pollen is enough to account for the slight excess of dark or light grains upon the ears in question.

Out of this lot of ears it is possible to select, with reasonable hope of securing a (1) "White-Mexican" and a (2) "White-Gentleman." The former would have plump twelve to fourteen-rowed ears of a very desirable size and shape and quality, with the grains long and the cob correspondingly small. The latter might result in a zigzag variety, with earlier plants and finer ears than the original "Gentleman." The possibility of fixing a type with only the upper end of the ear zigzag, as shown by No. 3, is not beyond consideration, should such a form seem desirable.

First Generation of Four New Crosses.

A block in one corner of the Gardens was occupied with fifty hills of "Mexican" upon "Banana" $(\frac{99}{6})$ planted early, and alongside of it, but planted three weeks later, was a quantity of "Mexican" upon "Striped Evergeen." The male parent, while the same in both, was mated in the first instance ("Banana") with very early sort, and in the other a medium-late kind of the evergreen group. The difference in time of planting was not quite sufficient and the "Mexican-Banana" plants were detasseled as soon as their ears were served. All suckers had been previously removed. A number of the earliest plants in the adjoining "Mexican-Striped Evergreen" block were also detasseled to prevent their possible mixing with the latest of the former cross. In ordinary seasons these precautions would probably not have been needed, but the prolonged drought hastened the blooming of all plants like corn, and particularly the later sorts. It is, however, better to plant the seed of all blocks of corn that have the same rate of growth fully five weeks apart, to make sure of freedom from mixing. The later-planted corn has better conditions, as a rule, and reaches the tassel stage much quicker than the same variety of corn planted earlier and in a cooler soil with shorter days. The mixed nature of the grains resulting from the first generation is shown in the set of six ears in the upper left-hand corner of Plate II. The ear upon the right of the six has much of the shape and zigzag arrangement of the grains characteristic of the "Banana."

Alongside of the above-mentioned block, and planted three weeks later, was the cross of "Mexican" upon "Striped Evergreen" $(\frac{99}{27})$. The time between the flowering of this cross and the one previously mentioned was not satisfactory, and the work of detasseling was needed to prevent mixing between the two blocks. There is quite a difference between these two crosses, both in plant and ear. The first produces a tall plant with narrow, erect foliage, while the second has long, broad, drooping leaves upon stout stalks. The differences between the ears are shown in the upper row in Plate II., the six to the right of the middle being the "Mexican-Striped Evergreen" cross. About half of the ears were a mixture of black and white grains—three-quarters black to one-quarter white—while the others were with both the dark and light grains marked, upon the embryo side in particular, with the

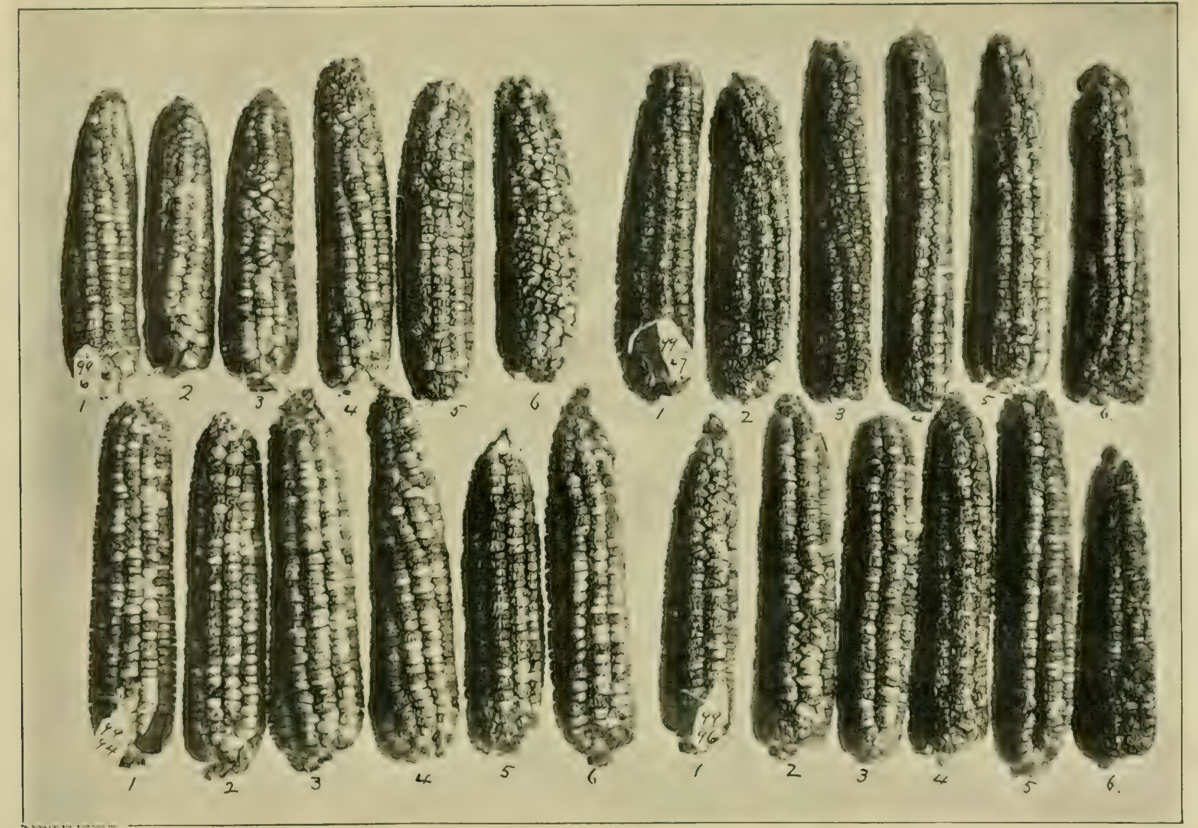

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PLATE II.

Four sets of six ears each, representing the second generation of "Black Mexican" upon "Banana" ($\frac{99}{6}$); "Striped Evergreen" ($\frac{99}{27}$); "Garwood" ($\frac{99}{94}$); and "Malakhov" ($\frac{99}{96}$)

red stripes characteristic of the mother plant. One ear had all the grains of a dark red, but showing by darker color the proportion of mixture with "Mexican" blood of the other ears.

The "Striped Evergreen" has the peculiarity of "throwing red ears," and this tendency was still active even in the above cross. The block was not prolific, but it remains to be seen what this cross can do under favorable conditions for growth.

The "Mexican-Garwood" ($\frac{99}{94}$) block was planted with dark grains from ears of a kind of corn secured from Mr. Gardner, of this State, who has practiced selection with it for a number of years, until it is a fine, uniform strain, approaching the "Evergreen" group of sweet corns. The plants were satisfactory in size and showed much vigor under the very trying conditions for growth. A set of six ears is shown in the lower left-hand corner of Plate II. They were larger in diameter than any other of the four crosses under consideration, and average twelve rows, instead of eight, as in the "Mexican" parent. The white grains are practically one-quarter of the whole number.

The last of the set to be mentioned, because its list or record number is higher than any of the others, is the "Mexican-Malakhov" ($\frac{99}{96}$). The stalks were slender and medium size, due to the smallness of the mother in the cross, and, like it, there was the desirable earliness. The ears, shown in a set of six at the lower right-hand corner, are fairly long and slender, and, of course, eight-rowed, as is the case with both parents. There is promise of getting in this cross a fairly prolific and early sweet corn of superior quality.

By planting the white grains from each one of these crosses, and with a few years of selection, it seems probable that four sorts of white sweet corn may be secured, some of which may prove of merit. In the same manner, by choosing the dark grains of each cross and eliminating the white grains, as they appear in decreasing numbers from year to year and selecting for desirable form of ear, another set of dark sweet corns may be secured, differing widely in some instances from the original "Black Mexican." Thus from the "Malakhov" cross great gain in earliness might be expected, while with the "Garwood" a finer, thicker, longer-grained ear might be secured, with nearly the same lateness as the male parent.

The "Malakhov" Sweet Corn.

The "Malakhov" sweet corn, previously considered in this report and for last year, through the courtesy of Professor N. E. Hansen, horticulturist of the South Dakota Experiment Station, and Professor W. W. Tracy, of the United States Department of Agriculture, was distributed to eighty-four growers, many of whom have reported favorably upon its earliness and sweetness. In the Gardens it was so early that the dry weather, which seriously harmed later sorts, did not materially affect it. By the 10th of July the ears were old enough for the table, and, while small, the quality was good. Some ears were allowed to ripen, and grains from these planted late in July gave a crop, ears of which were ready for cooking upon the 20th of October. The fact that two crops were grown in a single season is sufficient evidence that the "Malakhov" has the merit of earliness. That it is not profitable for commercial purposes seems equally true, and for this reason it has been crossed with more prolific sorts, which are medium early in order to increase the yield, at a possible loss of some of the earliness. Seed of this cross, of which there are a few quarts, is ready for distribution.

Cross of "Black Mexican" upon "Golden Bantam."

A block of twenty hills was planted with dark grains upon an ear of "Golden Bantam" (34), and were evidently the color-marking of the "Black Mexican" (99), the cross being expressed by the fraction $^{99}/_{34}$. The soil and season were very unfavorable and only a few ears were secured. These give the following result in number of black and yellow grains:

Ear No.	Dark Grains.	Yellow Grains.	Mixed.
1	128	46	9
2	130	38	5
3	149	46	4
4	95	22	2
5	85	27	0
6	81	35	2
7	50	21	1
Total	718	235	23
Theoretical	732	244	..

This shows that the black is dominant over the yellow in the ratio that closely agrees with the theoretical numbers that one obtains under Mendel's law.

The mixed grains, while few, are interesting. Some of them are without any color ("white"), while others are mottled black and yellow, and a few are pale lead color. An occasional grain has the dark color only upon one edge or flat side, as if the black and yellow pigments had not been thoroughly mixed together.

Notes upon "Ruby" Sweet Corn.

In 1904 the "Ruby" was grown as No. 76 in the list of sweet corns, and the record shows that its yield was poor, only four fair-sized ears being obtained, averaging four and one-half inches in length. It is one of the late kinds, and, as the name suggests, has the cob and husks of a rich, reddish purple. Upon one of the ears were four yellow flint grains, and these were planted by themselves, far from any other sweet corn. Soon after the plants were up it was noticeable that two of them were red in stem and midrib of leaf, while the other two had the green color throughout common to ordinary corn.

The only yellow flint corn grown in the set the previous year was the "Bryant." It was No. 7, and therefore 180 feet distant from the "Ruby," and it is assumed that the grains planted in isolation this season were a cross of the "Bryant" upon "Ruby."

The "Bryant" is "a small, eight-rowed, early yellow flint," as the record runs, and is therefore a sharp contrast with the "Ruby," with white, wrinkled grains—a true sweet corn—"easily distinguished by its deep purple husks, sheaths and cob."

A count of the grains upon a small ear from a stalk of the "Ruby" type of plant showed 44 white grains and 148 yellow kernels. According to the Mendel principle of heredity, the theoretical number of white grains is 48 and of yellow ones 144.

A week later (September 2d) an ear was taken from the other "Ruby" plant, which plant was larger—fully seven feet tall—and, like the former, red throughout, including tassel and silk, excepting only the main portions of the leaf blades, which were of nearly the usual shade of green. This second ear was seven inches long, eighteen-rowed and well filled out.

The following is the count of grains according to the color and texture:

Row.	Yellow Flint.	Yellow Sweet.	White Flint.	White Sweet.
1	11	5	3	1
2	13	5	2	1
3	18	3	2	1
4	12	5	4	0
5	12	4	3	0
6	12	3	2	1
7	5	4	5	1
8	15	4	2	1
9	20	2	2	2
10	19	2	2	2
11	15	5	2	2
12	12	7	1	4
13	19	5	4	1
14	14	5	3	2
15	18	4	3	0
16	13	4	7	2
Totals	228	62	44	21

Total yellow 290. Total flints 272. Total sweets 83.

The above calculation is based upon the idea, under the Mendelian principle, that both yellow color and flinty texture are dominant characters over white and soft qualities, respectively, and the actual count is as near as might be expected to accord with the assumption, in view of the modifying circumstances. The ear showed twenty-two dark grains in addition to those that have been classified in the above table, and these were due to the effect of a dwarf purple popcorn that was grown in the vicinity of the "Ruby" without the expectation that the flowering season of the two sorts would in the least overlap. All of the dark grains are of the flint type, as expected, and a majority of them show a mixture with the yellow.

Color of the Cob.

The color of the cob is perhaps a character that obeys the Mendelian rule in breeding. Thus a block of twenty hills of "Black Mexican" upon "Early Windsor," the latter having a reddish or "rusty" cob, gave thirty-three ears, ten of which were with white cobs and twenty-three with a color like the mother of the cross. In another block was grown a cross of "Perry's Hybrid" upon "Ne Plus Ultra," the former having the reddish cob quite frequently, and as a result there were seventeen "rusty" and twenty-three white cobs. Failure of a nearer approach to the theoretical ratio of three to one (the colored cob naturally assumed to be the dominant) may be found in the fact that the "Perry's Hybrid" does not have the character of reddish cob in all instances. This mixture of strongly contrasting cobs in itself suggests that the character is one that does not blend, but instead remains in full force, even in a cross-breed, in which one of the characters of color of the cob has not been removed by selection.

Crossing of Sweet Corn in 1905.

Upon a strip of the new ground fifty-nine varieties of sweet corn were grown, under the following conditions: Lengthwise of the strip, thirty-three feet wide, row No. 3 was planted with "Black" popcorn; row No. 6 with "Adams," and row No. 9 with "Golden Bantam."

From the hundred and more numbers of the varieties of sweet corn only those were selected that are recorded as "white"—that is, all those that are colored and those of a flint or dent nature, whole or in part, were excluded, which resulted in the list being limited to the following:

1. "Acme," Fmr.
5. "Asylum," Hlm.
6. "Banana," Fqr.
9. "Early Maine," Chl.
*11. "Champion," Hen.
*12. "Chicago Market," Cur.
*14. "Columbus Market," Liv.
15. "Cory," Jerr.
*19. "Country Gentleman," Exp.
*20. "Crosby Early," Drr.
21. "Crosby Medium," Munson.
*22. "Don," W. & D.
*23. "Egyptian," Fqr.
*24. "Eight-Rowed," Thr.
25. "Ferry's Early Evergreen," Fer.
*28. "White Evergreen," Bur.
*29. "Essex Early," Ggy.
30. "Eastern Early," Chl.
*31. "First in Market," Ham.
*33. "Early Fordhook," Bur.
*39. "Henderson," Hlm.
*41. "Hiawatha," Wd.
**42. "Hickox Improved," Liv.
*43. "Honey Dew," Chl.
**48. "Lvs. Evergreen," Liv.
*51. "Marblehead," Ggy.
54. "Oakview Market," Fqr.
*55. "Maule's XX," Mau.
57. "Metropolitan," May.
58. "Minnesota," Bru.
*61. "Moore's Concord," Thr.
*62. "Ne Plus Ultra," Thr.
*63. "Nonesuch," Hlm.
64. "Old Colony," Fmr.
*65. "Peep O'Day," N. K.
*67. "Pharaoh's Dream," Iow.
69. "Potter's Excelsior," Drr.
*70. "Premier," Brk.
*73. "Premo," Hlm.
**75. "Roslyn Hybrid," Drr.
*76. "Ruby," Bur.
*77. "Russell's Prolific," Vk.
78. "Shakers' Early," Hlm.
80. "Silver Coin," Liv.
*81. "Stablers' Early," Bur.
83. "Stowell's Evergreen," Drr.
86. "Early Sunrise," Iow.
88. "Triumph," Drr.
89. "Early Windsor," May.
90. "Zigzag," Hlm.
91. "Zigzag," Brk.
**94. "Garwood," Gardner.
95. "Malakhov," Hansen.
98. "White Mexican," Sox.
*101. "Giant," Mau.
*102. "Howling Mob," Bur.
103. "Mammoth Early," Ggy.
*104. "Oregon Evergreen," J. & S.
*105. "Top-Notch," Hlm.

The last five are varieties that had not been grown before at the Gardens, and under the unfavorable circumstances it is not fair to either praise or condemn them. All but one received a single star for product at harvest time; none of the ears were picked green and tested as to table quality. They were generally promising, and it is with regret that they could not have been compared with the old standard varieties in every particular.

A row of each ran across the strip and consisted of eight hills, the series being broken in each case by a hill of "Black Pop," "Adams" and "Golden Bantam," respectively. The plan was to breed upon the white sweet sorts the three last-named distinct varieties, thus getting a cross of each of them, each mixed grain to be marked by dark flint, light flint and yellow sweet, respectively.

The season was unusually dry during the period of growth of the early varieties and the crop from these was unusually small, several of which being practically a failure. Of the three "breeders," so called, both the "Black Pop" and the "Golden Bantam" were for the same reason a small crop, and the "Adams," while better, gave but a poor yield. Crosses were, however, obtained with all the varieties that gave any sizeable ears. The white sweet sorts that did the best under the very trying circumstances are marked with a star in the list under test. Four of special merit are double-starred.

In the breeder row of "Black Pop" containing fifty-nine hills were two stalks larger and later than the others that produced an ear each quite different from the regular type. Instead of a slender ear with the grains uniformly black was one over seven inches long and nearly two thick, with sixteen rows of vari-colored grains, about one quarter of which were white and the remaining three-fourths nearly evenly divided between yellow and a mixture of dark and dark yellow. It may be that the grain producing this plant was a mixture of white and black, the black obscuring the white blood, or else it would have been observed in the shelling of the seed from the black ear at time of planting. If it were a mixture of black and yellow it might have passed unnoticed, but then it is not easy to account for the quarter of white grains. If it were a white grain (flint, of course) the large amount of black grains is easily accounted for, but not so the equal number of yellow grains, because the "Golden Bantam" was twenty-one feet away and it did not impress itself to a like extent upon any other ears that distance away. But most difficult, under this last supposition, is the explanation of the large number of grains that evidently show a mixture of the black and yellow.

In the row of "Adams," which is a white dent, the marking of the "Black Pop" was often strongly in evidence, a fact to be expected. These grains were usually finely mottled, giving them a pink or purplish shade, but in shape they were that of the broad-topped dent of the mother plant.

It is interesting to note that some ears showed several wrinkled grains of the ordinary sweet type, a fact not easy to account for unless it be the result of a previous cross upon it of sweet corn, the seed not showing the fact. If a grain of genuine sweet corn had been planted it needed to escape the trained eye of the experimenter, and then the number of sweet grains in the offspring might naturally be greater than that found. Similar observations were made last year.

Occasionally a yellow-colored grain, always flint, was found upon the "Adams" ears, suggesting the effect of the "Golden Bantam."

"Voorhees" Corn from Various Regions.

As a result of the distribution of "Voorhees" corn to the Experiment Stations, the following representative list was made up for comparative tests the present season:

No. 1. Vermont. Professor W. Stuart, Burlington, Vt.
" 2. Connecticut. Professor F. A. Gulley, Storrs, Conn.
" 3. New Jersey. Mr. S. A. Gardner, Maplewood, N. J.
" 4. Pennsylvania. Professor Geo. C. Butz, State College, Pa.
" 5. Virginia. Professor H. L. Price, Blacksburg, Va.
" 6. North Carolina. Professor W. F. Massey, Raleigh, N. C.
" 7. Louisiana. Professor F. H. Burnette, Baton Rouge, La.
" 8. Illinois. Professor J. C. Blair, Urbana, Ill.
" 9. Iowa. J. A. Kelsey, Dunlap, Ia.
" 10. Kansas. Professor Albert Dickens, Manhattan, Kan.
" 11. Colorado. Professor W. Paddock, Ft. Collins, Col.
" 12. Nevada. Professor P. B. Kennedy, Reno, Nev.
" 13. Washington. B. E. Musser, Bellingham, Wash.
" 14. Hawaii. Professor J. T. Higgins, Honolulu, H. I.

There were two rows of each lot, the rows running across the thirty-three-foot strip; that is, the area covered was thirty-three by eighty-four feet, the hills being three feet apart both ways.

The series began with two rows planted with Vermont-grown seed and ended with that from Hawaii. All came up fairly well excepting the sample from North Carolina, and these two rows were replanted with grains from another ear from the same lot, and this grew and made the largest corn, by a foot and a half, in the whole block. This is mentioned to show how unfavorable was the season here for sweet corn planted, as this was, early in May. The test amounted to but little, for the corn did not grow on account of the prolonged drought in May and June. After the rains came it was too late, as the short stalks had set their ears, and the crop was a partial failure. In view of the very late moist autumn, the results perhaps would have been reached by a late planting, as the only two rows with full-sized stalks and ears were the ones in the replanted rows for North Carolina.

Upon June 2d the record shows that the most promising rows were New Jersey, Virginia, Illinois, and Iowa, followed by Connecticut. Kansas, Nevada, Washington, Hawaii, Vermont and Colorado were about equally poor, and, as before stated, North Carolina was nearly a failure. It was noted at this time that the color of the young foliage was somewhat different in the plants from the far-western-grown seed. There was a large maple tree at the end of the strip and nearest to this set of samples, which may have accounted for this appearance, as it did without doubt for some of the dwarfishness of the plants later in the season.

In the ears harvested there was nothing noted to indicate any change possibly due to the different conditions under which the seed had been grown. The experiment teaches emphatically the difficulties that lie in the path of one who would make tests of climatic influence upon future offspring among such plastic annual plants as corn.

It may be said that the ears were generally entirely red, with the single striking exception of those from the Connecticut rows, which were much mixed with white.

A LIST OF THE POPCORNS GROWN IN 1905.

The following is a list of the commercial varieties of popcorn grown upon the home grounds the past season. The soil devoted to this purpose was not well adapted to the crop, and the season being unfavorable, the results as to yield were not satisfactory. Also, one end of the plot was somewhat overshadowed by a maple tree, and this doubtless prevented the rows from No. 26 to No. 31 from being comparable with the others. The last five kinds, Nos. 31 to 36, upon account of their color and other peculiarities, were grown upon separate plots, widely separated from each other and the main portion of the popcorn area. In short, Nos. 1 to 31 were grown in a strip with a row of eleven hills across it to each number and in the order given in the accompanying plate. The tree stood at the end and twenty feet away from the side of row 31.

There was a difference in the habits of growth among the various numbers. The list follows, with source of seed and some remarks appended to each:

No. 106. "*Red Beauty.*" Buck. It was the earliest of all; a very small red rice that gave but a few ears.

" 107. "*Red Rice.*" This seed was received from Brazil through the U. S. Department of Agriculture. The plants were very stout and ten feet in height and so late that no mature seed was secured. The ear shown in the group was gathered upon October 10th. It is evidently too slow in habit for the New Jersey climate. A red color is present in all parts of the plant.

" 108. "*Red Rice.*" A. D. Co. This is a medium small and early corn with ears of greater diameter than No. 106. The grains are broad and approach the pearl in shape.

" 109. "*Red Rice.*" U. S. D. A. This is similar to the last, somewhat larger plants and more productive. The ears are more slender and the grains of a lighter red. This and all the other red rice samples produced white ears, but in no instance was there any mixing of these two colors upon the same ear.

" 110. "*Bronze.*" Ggy. This is a very small and early corn with slender stalks that quickly fall to the ground. The ears were small and the grains in many rows had the very sharp tip strongly developed.

" 111. "*Bronze.*" U. S. D. A. This seemed the same as the last in all respects. The bronze and the red rice are much alike and both frequently produce white ears. The "bronze" color is midway between the red and yellow.

" 112. "*Rice.*" A. D. Co. This is a medium tall sort and quite early. The ears were stout and short with the grains closely set and not sharp-tipped.

" 113. "*Yellow Rice.*" U. S. D. A. Brazil. This was one of the very tall sorts, the plants being from eleven to thirteen feet high and were only coming into tassel on the first of October. The plants were very leafy and gave evidence of being of value as a forage crop. Standing upon tiptoe, the writer was able to reach only to the middle ear with the tallest specimens. The sample shows only the slender nature of the cob and the forming grains.

" 114. "*Queen's Golden.*" A. D. Co. This is a sort with very large plant and late in maturing its ears, which are handsome in shape and with bright yellow pearl grains.

" 115. "*Queen's Golden.*" Field. The plants were large and ripened their ears about October 1st. The color of the grains is the same as for No. 114, but their shape and arrangement upon the cob are different. The engraving shows these peculiarities.

No. 116. "*Queen's Golden.*" J. & S. This was somewhat smaller than the last and the ear more tapering, with the grains of a darker yellow. A very handsome corn and presumably eastern grown, which may account for the smaller size of plant and earlier maturity.

" 117. "*Queen's Golden.*" Vau. As to plant this was the same as the last, but the ears are sharper pointed and the grains much larger, with a pointed end, suggesting the "rice" form. Many grains failed to mature and the ears were all with irregular rows.

" 118. "*Queen's Golden.*" Y. & H. In plant this was nearly like the last two, but the seed did not give a good stand. The ears are long and slender, with the grains smaller than any other of the "Queen's Golden" group and in twisted rows upon the cob.

" 119. "*Amber Pearl.*" Hend. This gave a set of stout plants of medium size and productiveness. The ears are long and slender, rows straight and grains flat topped and rectangular and in color approaching amber.

" 120. "*Yellow.*" U. S. D. A. India. This is a stout, medium small and medium early corn, with the husks very stiff upon the short, pointed ears. The straw-colored grains are large, of the pearl type and somewhat irregularly disposed on the cob. It is different from any other in the list.

" 121. "*Eight-Rowed.*" A. D. Co. This is a small and early corn with the ears very slender and usually eight-rowed. The one in the picture, however, is ten-rowed. The grains are large and rectangular and of the plain "white" color.

" 122. "*White Pearl.*" Brk. This is a tall, late-maturing sort, averaging nine feet high and with the ears still green upon the first of October. The ears are cylindrical and fourteen to sixteen-rowed, with the grains small and of good length.

" 123. "*White Pearl.*" A. D. Co. This is practically the same as the last, but with us it was far less productive and the ears much smaller.

" 124. "*White Pearl.*" U. S. D. A. This does not differ from the last two and gave one of the most prolific rows of shapely ears.

" 125. "*Mapledale Prolific.*" J. & S. This is medium early sort, with slender stalks. The ears are rather stout, with a tinge of rose in the small shining grains.

" 126. "*Mapledale Prolific.*" Vau. This is quite like the last with the slender stalks not able to remain upright after maturity. The ears are stout and the rows many of small, hard, white grains.

" 127. "*Silver Lace.*" Burp. This is nearly the same as the last in form of plant, but the ears are smaller, more tapering, and the husks are remarkably soft when mature.

" 128. "*Rice.*" U. S. D. A. Brazil. This sort was one of the largest of the list, with very tall, leafy plants, just coming into silk upon October 1st. The immature ear, gathered upon the tenth of that month, is shown in Plate III.

" 129. "*Rice.*" A. D. Co. This is a medium-sized sort, red throughout, that stood up well. The ears medium early, and are not large, with the large, sharp-pointed, "white" grains, often irregularly placed.

" 130. "*Rice.*" A. D. Co. (No. 2). This is somewhat larger and later than the last, with the grains quite uniformly in rows.

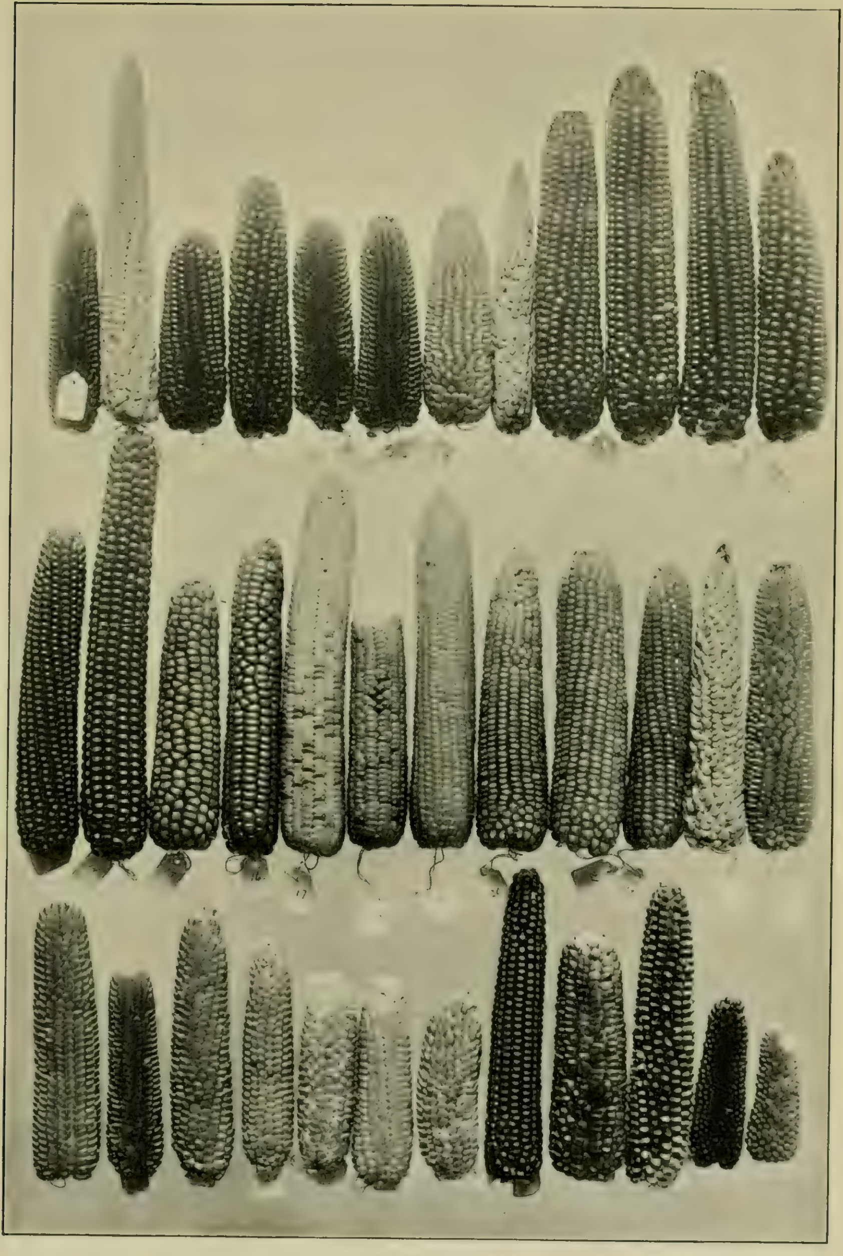


PLATE III.

Sample ears of thirty-six lots of Popcorn grown upon the Experiment Grounds during 1905.

No. 131. "*Rice.*" A. D. Co. (No. 3). This is a small sort, green throughout, and with the ears short.

" 132. "*Rice.*" A. D. Co. (No. 4). This is a medium-sized sort, with red color throughout, and the ears with the grains somewhat as in No. 129.

" 133. "*Rice.*" J. & S. This is nearly the same as the last, but did not yield as well. The grains are less pointed.

" 134. "*Rice.*" Vau. This is the same as the last.

" 135. "*Rice.*" Y. & H. This is the same as the last two.

" 136. "*Snowball.*" Buck. Seems to be the same as the last three. All of these last were too shaded for good results.

" 137. "*Black.*" A. D. Co. This is a characteristic, small, early variety. with slender, usually curved ears, bearing large, dark grains, varying from lead-colored to nearly black.

" 138. "*Striped.*" Buck. This is a strong-growing sort, maturing medium late and bearing short, stout ears, with the large rice grains more or less striped with amber.

" 139. "*Tattooed Yankee.*" Chl. This is a tall, slender-stalked sort that falls badly. The ears are long, bearing large, much-pointed grains that are mixed yellow and black.

" 140. "*Dwarf Purple.*" U. S. D. A. This is a quick-growing sort, making a height of three or four feet and producing small, tapering ears, with the pointed grains of an amethyst color and arranged irregularly.

" 141. "*Dwarf Yellow.*" U. S. D. A. This is a most decided dwarf, the plants not being over two feet high and the ears as many inches long. The pointed grains are of a delicate straw yellow and of the zigzag type in their arrangement.

This list of thirty-six numbers, samples of which are shown in Plate III., may be divided, first, into the standard and dwarf, and the former into the rice and the pearl. Of the rice type there are the white, red, bronze, striped and tattooed. The pearls group themselves into the white, yellow and black, and the white pearls may be divided again by the separation of the sort known as the eight-rowed, because of the characteristic which its name bears.

It is too early in the study of these plantings to determine the number of well-defined varieties. The "Red Rice" and the "Bronze" are quite alike, save in the less developed red in the latter. Both have the peculiarity of having many white ears, and these are not distinguishable in the "red" and "bronze" rows. The "Amber Pearl" may have peculiarities which definitely separate it from the "Queen's Golden." The "Mapledale Prolific," while showing differences from the "White Pearl," are, as seen in the present test, no greater than among the several rows of the "pearls" themselves. In the same way, the "Silver Lace" does not appear to be distinct from the "White Pearl." The

"Snowball" is apparently a white rice. The "Black" is unmistakable, but the "Striped" and "Tattooed Yankee" need to be studied to determine whether their peculiarities are not those of mixing rather than of a fixed variety. For example, opportunity was taken to grow the latter in two isolated blocks, the one planted with only the yellow grains and the other with black kernels, and as a result of the first season the yellow seed produced fifty ears, a full half of which were entirely yellow, and the remaining half showed much less of the dark grains than the block planted with the dark grains only. It looks as if this sort might, by selection, be resolved into its yellow and dark constituents, which might be old varieties. One of these might be a yellow rice, a form that it is noted is not present in the above list, and I do not recall having met with it.

Plate IV. shows a selection of perhaps the most popular sorts of popcorn, and along with the seven ears are given sections across the ear, a watch-glass containing shelled grains and a few samples of the popped corn. Beginning at the left hand, the "Queen's Golden" shows a long, tapering ear with rather large grains, which, when popped, show some of the yellow throughout the whole grains, giving a creamy appearance which is pleasing and quite different from any other of the seven sorts. This attractive, rich color is not shown in the popped grains which are placed directly above the ear. The "Black" is one of the best to pop, and yields large grains with the flesh of almost chalky white, in striking contrast to the fragments of the hull. The heat seems to reduce the dark color of this exterior to a dull brown. Were the "Black" a more prolific sort there is reason for its being quite popular. The "Speckled Pearl" here shown, but not grown in the regular series because of its dark grains, seems to be one of the popular sorts found generally in our local markets. The ears, in shape and general appearance of the grain, are quite like the "White Pearl." It may be earlier, and this would add to its popularity. By selection, ears with cherry-colored pearl grains might be secured that would be very handsome, in addition to other good qualities. The "Speckled" produces a superior popped product.

The "Eight-Rowed" has proved to be, after repeated trials, one of the very best varieties for popping, and its large grains yield a product that takes on many fantastic shapes, due perhaps to the unusual width of the kernels. In the "White Pearl" we have perhaps the most widely-used corn, the "White Rice" being a good second in this regard. The

Notes upon "Magnus-Ponderosa" Crosses.

A block of thirty plants of the cross of "Magnus" (75) upon "Ponderosa" (103) were grown. This was the second generation of the mingling of these two varieties, both strong in their peculiarities. The "Magnus" is a standard, coarse-leaved ("potato leaf") sort, with remarkable vigor, producing a tall plant and fruit of medium size and quite uniformly deep apple-shaped. The wall is thick and the seed cavities are from five to eight, with usually a central core unbroken with seed cells. The "Ponderosa," one of the very popular tomatoes, is a very vigorous plant of the fine-leaved type and produces fruits often of unusual size, but sometimes objectionable because of their flatness and irregularity of outline. The center is much broken up by the many seed cavities, in which the seeds are comparatively few in number. The two varieties, it is seen, differ in character of foliage and form and internal structure of the fruit. They both agree in the color, which is the so-called "pink" or "purple."

During last winter plants of both these sorts and the cross between them were grown in the greenhouse, and even under the unfavorable conditions of lack of abundant sunlight, due to high neighboring buildings, they showed that vigor and fruitfulness were their strong qualities.

In the field the plants were of the second generation and showed the two types of foliage, there being twenty-one of the fine-leaved and nine of the coarse-leaved kind. This accords somewhat closely with what might be expected under Mendel's law where the fine-leaved type is assumed as dominant and the coarse-leaved the recessive character.

The fruits have all been of the "pink" color, and therefore true to both parents, as might be expected. There has been quite a range in size and shape among the various plants. Greater uniformity prevailed in the coarse-leaved plants, and this is as if the "Magnus" blood was dominant, but the fruits were not the same as those of "Magnus" grown elsewhere for comparison. The fruits of the "Magnus" type were larger and the seed cavities were more numerous than the true "Magnus."

In other words, the size and shape of the fruit are altered in the recessive plants of this cross.

The greatest improvement is seen in the fine-leaved plants, where, also, the largest amount of variation in fruit is seen. Some of these plants produced largely of apple-shaped fruits—for example, near that of a good "Baldwin." Sixteen such ripe fruits were taken from a single plant at one time, the total weight of which was six and a quarter pounds. Other plants produced fruits in smaller numbers but of much larger size, showing more of the "Ponderosa" than the "Magnus" qualities, but less irregular and flat than the pure "Ponderosa." It is of those plants that yield the apple-shaped fruits, all of them sufficiently large, that most is to be hoped for in this cross, and from such plants a quantity of seed has been secured. The aim has been to obtain a prolific plant, the pink fruits being large and deep, with thick wall and a juicy core, somewhat broken by small seed cavities, and with the number of seeds comparatively few.

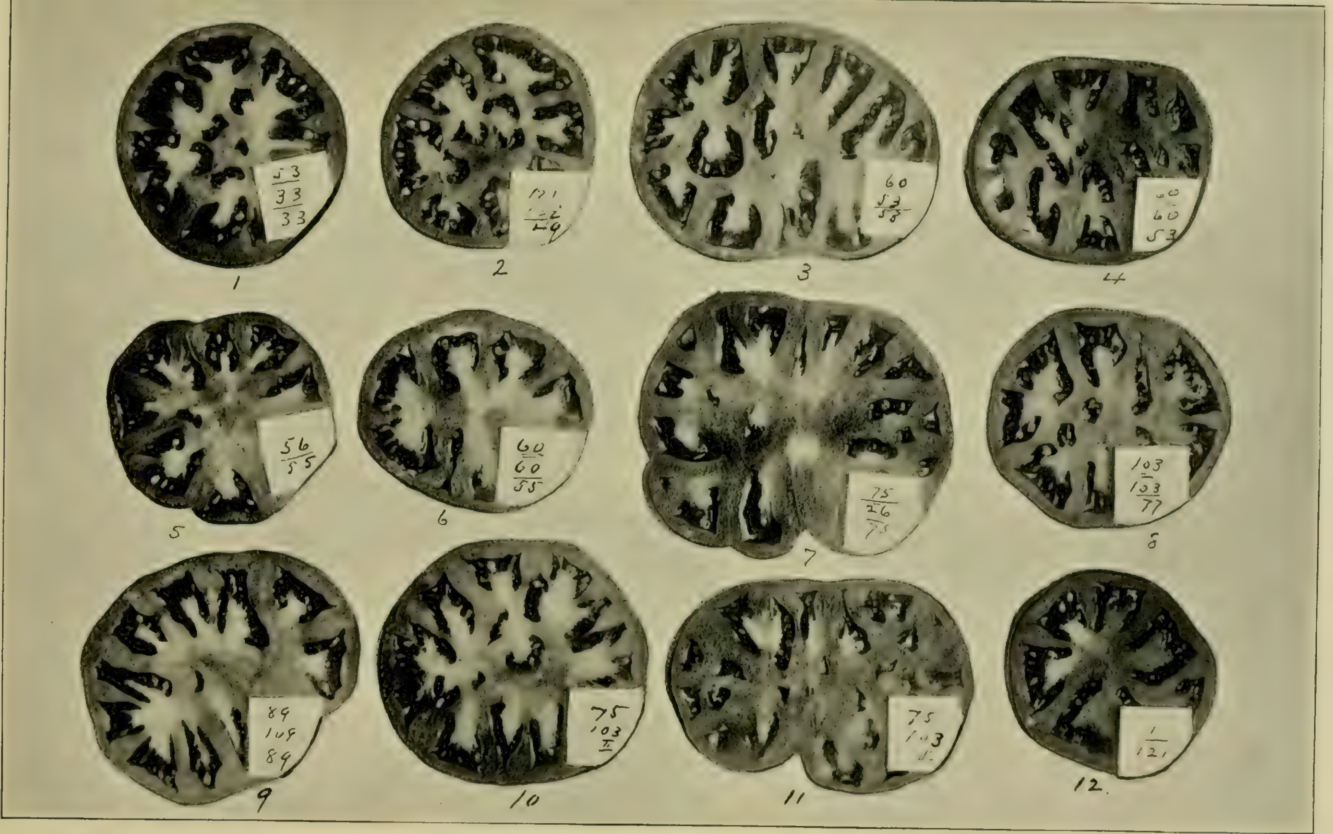
A slice-view of a fruit of the "Magnus-Ponderosa" cross is shown at 10, in Plate V., and one of a third generation at 11. Ten plants of this last generation were grown in a separate block from the above, and were full of vigor and fruitfulness.

Notes upon "Champion-Magnus" Crosses.

Because of the dwarf habit of the "Champion," and the fact that it has the fine-leaf type of foliage, a cross of it with the "Magnus," a standard, coarse-leaved variety, admitted of a wide range in the offspring. From a single fruit of such a cross—"Magnus" upon "Dwarf Champion"—eighty-five plants were obtained and set in a block in the Gardens. From an early stage in the growth of the seedlings it was seen that at least four types were in evidence, namely, the standards in both coarse and fine leaves, and dwarfs, likewise, of the two forms of foliage. This distinction was maintained throughout the season, so that side by side grew plants of widely different aspect.

A count of the forms and the number of good-sized fruits for each plant resulted in the following:

Standard, fine-leaved	plants,	49	theoretical,	48—	Average fruits per plant,	22
Standard, coarse-leaved	"	16	"	16—	" " " "	19
Dwarf, fine-leaved	"	13	"	16—	" " " "	15
Dwarf, coarse-leaved	"	7	"	5+	" " " "	11


1
53
33
33
2
3
60
4
60
60
53
5
56
55
6
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60
55
7
75
26
75
8
103
103
77
9
89
109
89
10
75
103
11
75
103
12.
1
121

PLATE V.

Some of the Crossed Tomatoes shown sliced. The card giving the breeding numbers are inch squares.

The number of plants on each type conforms somewhat closely to Mendel's law, if it is assumed that standard form of plant and fine-leaved foliage are the dominant characteristics and the dwarf plants and coarse leaves are the recessives. The number of plants is, however, all too small to more than arrive at a suggestion from this single instance.

In the number of marketable fruits per plant it is seen that the standard types outnumber those produced by the dwarfs. This does not decide that the latter are inferior but smaller in yield, as they are also much smaller in size. Double the number of dwarfs can be grown upon a given area, and even then the ground does not become a tangle of vines, as in case of the standards. The fine-leaved dwarfs, set twice as many to a given area, might give a much better return than when the standard, fine-leaved form is grown. The dwarf, coarse-leaved form is handsome, and the plants keep the upright position until the fruit is nearing maturity, when winds and rains cause them to bend bodily to one side.

During a heavy picking the fruits of each of the four types were kept separate and as a result some variation in size was noted, those of the standard, fine-leaved averaging the largest and the dwarf, coarse-leaved the smallest.

During a period when almost daily rains prevailed for a fortnight, the decay seemed to be almost equally distributed among the four types.

As was expected, the fruits were of the pink color, thus resembling that of both parents. There was one evident exception, in which the color was a distinct red, a fact suggesting that a seed had been fertilized with foreign pollen.

The fruits are quite uniformly larger than the "Champion" and close to the somewhat angled form of the "Magnus." In other words, out of this cross, by selection, four types of plant and foliage may be expected, all with practically the same form of fruit, but differing materially in stem and foliage. The coarse-leaved standards are the tallest plants, while the coarse-leaved dwarfs are the smallest. The greatest range in size is met with in the fine-leaved plants.

There was one plant that, while ranked with the fine-leaved standard type, was quite unlike any other in its foliage. The leaves showed a strong tendency to produce long, slender expansions, that were as far from the ordinary tomato foliage upon one side as the coarse-leaved type is upon the other. Several other plants with this filiform type of tomato foliage were met with among the crosses of the year. They seem of no economic value, but as a mutation attempts will be made to determine the permanence of the above-mentioned character.

Plate VI. shows the four types of foliage found in the "Magnus-Dwarf Champion" cross. At *a* is a tip of a dwarf, fine-leaved plant, at *b* a standard, fine-leaved, at *c* a dwarf, coarse-leaved and at *d* a standard, coarse-leaved plant. The older leaves of the plants show greater differences than their younger ones.

A Study of the Crosses.

The plan was to have the crosses in what may be called families—that is, associated with each cross it was intended to have the following: (1) male parent upon the cross, (2) the cross upon male parent, (3) female parent upon the cross, and (4) the cross upon the female parent. For example, the first cross upon the list is "Arcadia" (4) upon "Acme" 2, expressed in the record books by the fraction $\frac{4}{2}$. The "family" of which this is the head is:

$$\begin{array}{c}4\\ \hline\hline 4\\ \hline 2\end{array},\ \begin{array}{c}4\\ \hline 2\\ \hline\hline 4\end{array},\ \begin{array}{c}2\\ \hline\hline 4\\ \hline 2\end{array},\ \begin{array}{c}4\\ \hline 2\\ \hline\hline 2\end{array},\ \text{or}\ \frac{\text{m. p.}}{\text{x}},\ \frac{\text{x}}{\text{m. p}},\ \frac{\text{f p.}}{\text{x}},\ \frac{\text{x}}{\text{f. p.}}.$$

The double bar in the fraction separates the two members of the second cross; m. p. are the initials for male parent and f. p. for female parent. This gives double reciprocals of the cross with the parents and furnishes a set of four three-quarter "bloods," two of them upon the male and two upon the female side.

Full "families" were obtained in only a few cases, for example, "Arcadia" upon "Acme" $\frac{(4)}{(2)}$; "Ponderosa" upon "Marvel" $\frac{(103)}{(77)}$; "Magnus" upon "Ponderosa" $\frac{(75)}{(103)}$; "Mikado" upon "Princess" $\frac{(89)}{(109)}$; "Stone" upon "South Jersey" $\frac{(123)}{(119)}$; "Dwarf Stone" upon "Dwarf Champion" $\frac{(171)}{(153)}$; "Ignotum" upon "Red Peach" $\frac{(62)}{(178)}$, and "Ignotum" upon "Red Plum" $\frac{(62)}{(180)}$. There were many "families" with only a single member lacking. Attention is first given to the complete sets.

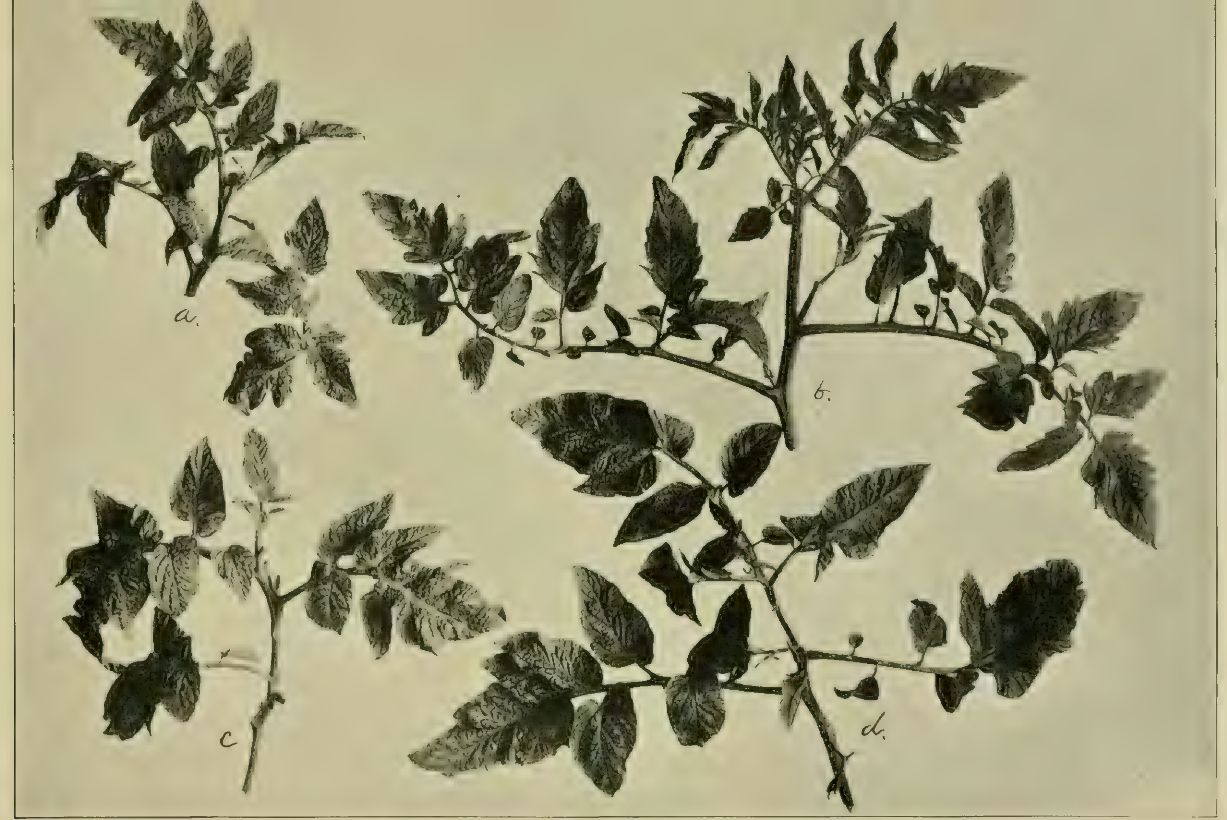

PLATE VI.

Four types of leaves of "Magnus-Dwarf Champion" cross from one mother fruit. At *a* dwarf fine, *b* standard fine, *c* dwarf coarse, *d* standard coarse foliage.

The "Arcadia-Acme" Family.

In the matter of popularity the two parents in this group are the extremes, for the "Arcadia" is not mentioned in the Tracy list,* while the "Acme" is exceeded in number of seed-houses handling it by only "Beauty," "Stone," "Dwarf Champion," "Perfection" and "Livingston's Favorite." The "Arcadia" is red-fruited, while the "Acme" is pink or purple. Both are early and the "Arcadia," having a larger fruit than the "Acme," it was the hope to increase the size of the latter and possibly secure some other advantageous characteristics.

The first cross—that is, a half blood—gave an even lot of average plants, three of which produced pink fruits that were comparatively smooth. The other three had red fruits, and these were somewhat flat and irregular. They were all early. The male parent upon the cross gave two types of plants—one like the "Arcadia," with large, flat, irregular fruits, and the other (two plants) like the "Acme," which were smooth and prolific. The row containing the reciprocal of the last did not differ from that essentially. In case of the "Acme" upon the cross, the plants were uniform in size and the fruits also smooth and larger than the "Acme." Four were pink and two red. The red-fruited plants were more productive than those producing the pink fruits. The reciprocal of the last—that is, the cross upon "Acme"—had only three plants, two of which were pink and one red. The fruits were smooth, medium-sized and quite like the last. It remains to be determined whether there is any substantial gain in this series of crosses over the parents.

The "Ponderosa-Marvel" Family.

The "Ponderosa" is a large, standard, fine-leaved variety of tomato plant that has become very popular for its great fruits, from which fact it takes its name, which are of a decidedly irregular shape but of a handsome "pink" color, while the "Marvel" is much less known, and differs in the more nearly smooth, medium-sized red fruits, which mature evenly and somewhat earlier than the "Ponderosa."

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* Bulletin U. S. Department of Agriculture, Bureau of Plant Industry. List of American Vegetables for the years 1901 and 1902, by W. W. Tracy, Jr.

There were four plants of the cross in its second generation, all of which were large and bore fruits in abundance of a size and shape quite intermediate between the two parents, excepting that they were all red. The records show that many of the fruits, because of the good depth, were extra fine in shape and did not have much of the irregularity so objectionable in the "Ponderosa." The expression "very fine, smooth" was used in connection with many of the fruits. One plant had an oblong fruit that possessed a remarkably fleshy interior. In the cross of the "Ponderosa" upon the above cross four of the five plants produced red fruits and one "pink," the latter being quite irregular and closely resembled the "Ponderosa." The whole row was very prolific. In the reciprocal of the last—that is, the original cross upon the "Ponderosa"—the plants were of large size, and three bore red and two "pink" fruits, all of which were large and somewhat irregular and flattened. In the three-quarter "Marvel" —that is, this parent upon the original cross—the six large plants all produced fruits that were somewhat of a blend of the red and "pink" of the two parents. The fruits are very large and nearly always smooth. The record shows that forty-six ripe, sound fruits were picked from the six plants at one time, and they filled to the brim a large-sized peach basket. These large fruits are with many seed cavities, some of them breaking the central core and giving a most desirable center of evenly-colored flesh. The reciprocal of this—that is, the original cross upon the "Marvel"—had four red and one pink-fruited plants. They were practically the same as the above in all desirable qualities. A slice-view of a fruit is shown at 8, in Plate V.

The "Magnus-Ponderosa" Family.

In the "Magnus" we have one of the most valuable of the coarse-leaved, standard tomatoes which was introduced by Livingston, and it has become quite popular for its fine, evenly-maturing, medium-sized, apple-shaped pink fruits. The primary cross for this family was made some years ago, and the third generation was grown in considerable numbers in the Gardens the past season. Plate VI., of the report for 1904, shows the foliage and fruit of this cross in connection with those of both parents. There are two types of plants in the cross of coarse and fine-leaved sorts, and the block of thirty plants from the same fruit showed seven of the coarse and twenty-three of the fine-leaved type. As to the character of the fruit and time of maturing there seems to be no difference, but in point of yield the plants with ordinary foliage outrank those of the "potato" type. In general, the fruits are like both parents—of a handsome pink and somewhat variable in shape. Some plants favor in this the "Ponderosa," while the larger number are globular, like the "Magnus," and lacking in the ribbed or angular form of the former variety. While not to be classed among the strictly early sorts, this cross is one well suited to give through a long season a full crop of handsome pink fruits that ripen evenly and yield a larger percentage of flesh than many standard sorts. The reasons for the selection of these two sorts have been given in previous reports, and the results show a combination of qualities that makes it superior to either parent. The objectionable shape and uneven ripening of the "Ponderosa" are removed, with a gain of size and percentage of flesh over the "Magnus." The yield is large and the season long. From one plant sixteen marketable fruits were picked at one time, all of them large and smooth enough for the choicest fruit and weighing six pounds and four ounces.

A considerable quantity of seed was saved from the best fruits of the best plants, which will be distributed in time for the next season.

Other members of the "Magnerosa" family were grown in the usual number—that is, a row of five plants—as follows: The male parent upon the cross 75 (75 x 103), giving what may be termed a three-quarter blood of the "Magnus," produced three coarse-leaved and two fine-leaved plants, with fine, medium-sized, round, smooth fruits, that did not show much of the "Ponderosa" characteristics. The cross worked upon the male parent (75 x 103) 75 was represented by only two plants, one of which was coarse and one fine-leaved. Here the "Ponderosa" was more in evidence in the irregularity of the fruits, but the instances were too few for any generalization. There is a strong individuality among plants of the best established varieties. The female upon the cross 103 (75 x 103) had five plants, all fine-leaved, but among the fruits there was less uniformity. Four plants had the fruits large and irregular and scarcely an improvement upon the "Ponderosa" in this respect, while the fifth bore round fruits of remarkable smoothness, from which seeds for further testing were saved. The cross upon the female parent (75 x 103) 103 gave fine-leaved plants which bore a large crop of fruit, and here, again, four plants strongly resembled the "Ponderosa" in irregular fruits, while one was prolific in fine, medium-sized tomatoes of a desirable length.

The number of plants in each row was so small that it is not safe to draw any conclusions as to the characteristics of reciprocals, but so far as this family is concerned there does not seem to be any difference which is the male and which is the female parent of a second cross when one of the units in the cross is the primary cross of the two bloods that are mingled. In other words, so far as the present test goes, there does not seem to be any difference whether "Magnus" is used as a male or a female to be bred to the cross of that variety upon "Ponderosa." A study of the members of this "family" shows that when "Magnus" represented three-quarters it was able to obscure the "Ponderosa" type of fruit quite extensively, and when the "Ponderosa" was three-quarters it in turn was dominant. There were enough exceptions, however, among the small number of plants to lead to the opinion that strong outcropping of the quarter-blood may be expected in such double crosses. Slice-views of fruits are given at 10 and 11, of Plate V.

The "Mikado-Princess" Family.

In this combination the two parents are of the coarse-leaved, standard type, the "Mikado" having green foliage and the "Princess" of a yellow color. The fruits are pink in both varieties. The primary cross was represented by five plants, all coarse-leaved, which produced large, fine, smooth fruits, with some russet upon the shoulder. In the cross of the male parent upon the cross 89 (89 x 109) the five plants were all coarse-leaved, but not satisfactorily prolific. The reciprocal of this, namely (89 x 109) 89, gave five plants practically the same as the last. Among the five plants of the female upon the cross 109 (89 x 109), three were coarse and two fine-leaved. Two of them were with yellow foliage and none were productive. The reciprocal of this last, namely (89 x 109) 109, gave five coarse-leaved plants, two of which had yellow foliage, and none were satisfactory in yield. It is seen that this cross among the coarse-leaved sorts did not produce plants with abundant fruit. The tomatoes produced by the parents and offspring in this "family," while of superior form, color and firmness of flesh, do not apparently warrant consideration, except by those who wish to have them as interesting types quite different from the quick-growing, prolific sorts.

It is also noted that the four yellow plants out of the twenty-five in the "family" were all among the two reciprocals where the yellow parent ("Princess") was the three-quarter blood. Had a larger number of plants been employed for each secondary cross, it is likely that the yellow plants would have been found in them all. This assumption is based upon the fact that there was no apparent blending of the yellow and green qualities, and the former is a unit character that follows the Mendelian law. Slice-view of a fruit is shown at 9, in Plate V.

The "Stone-South Jersey" Family.

The "Stone" is one of the most popular of the later varieties of tomatoes—in fact, it is one of Livingston's best in his long list of excellent sorts. It is a standard, fine-leaved, red-fruited, productive variety, medium in size and season, that was exceeded by but few in the score made in 1904. The fruit is solid, with a thick wall, ripens evenly and carries well. The "South Jersey" is a leading red sort among the early group because of its quick growth and large fruits. The latter are, however, very irregular and in striking contrast with the smoothness and uniform size of the "Stone." The first cross—that is, the "Stone" upon the "South Jersey" (123 x 119)—gave large plants, and, as expected, the foliage was of the ordinary sort, like both parents. The fruits were very large and quite irregular, but much superior to the "South Jersey" in this respect. The cross of the male parent upon the first cross 122 (122 x 119) gave large plants, with medium fruits that were comparatively smooth, but there was a lack of productiveness. The reciprocal of this (123 x 119) 123 produced very large and productive plants, with large fruits, that were irregular. The field note-book records that this cross might be good for canneries. There seems to be some difference between the reciprocals in this case of inbreeding. When the "South Jersey" is bred to the cross 119 (123 x 119) more earliness is obtained than in the last-named union of the same varieties, in other words, where there is three-quarters of the "South Jersey" blood. The fruits here were many, quite flat and cracked somewhat. The reciprocal of this, namely (123 x 119) 119, gave less objectionable fruits than the last and were a decided improvement upon the "South Jersey." There may be some loss in speed, but that remains to be determined.

The "Dwarf Stone-Dwarf Champion" Family.

In this group are combined two of the superior members of the dwarf class of tomatoes. The "Dwarf Stone" is a large, firm-fleshed, red-fruited sort that led in points of excellence in our trials with nearly two hundred competitors in 1904, while the "Dwarf Champion" has a much smaller fruit of a pink color. There is little to be said of the five sets of plants that constituted the family. The plants in all cases were dwarfs, as might be expected. The half-blood parent did not differ materially from the reciprocal quarter and three-quarter bloods. One point of interest was the apparent blending in the color, it being in all cases a dull red, instead of in part red and in part pink. The plants were all small, feeble and unproductive. The fruits that came to maturity were of good shape.

The "Ignotum-Red Peach" Family.

The "Ignotum" (62) is a standard, fine-leaved variety of tomato with red fruit, of medium size and earliness that gave with us a score of 83 good points out of a possible 100, in 1904. Its origin is unknown, it having made its appearance in the trial grounds of the Michigan Agricultural College twenty and more years ago, and has been a popular variety for a long time. The "Red Peach" (178) is a small, pink-fruited variety, the foliage of which is of a bluish tinge, and quite susceptible to drought and other unfavorable conditions. In the greenhouse, for example, the peach "blood" can be detected as well by the wilting, when water-supply is limited, as by every other leaf or stem peculiarity. The fruit, aside from its small size and few —usually three or four—large seed cavities, is characterized by a fuzz upon the surface, from which fact the name is given to this quite distinct group.

The second generation of the cross (62 x 180) gave vines of remarkably large size, all five with pink fruits, two of which bore the characteristic peach fuzz. The fruit, in size, varied greatly, some vines bore small tomatoes in large clusters, while others had smaller clusters with the fruit large enough for market. The cross of the male parent upon the cross 62 (62 x 178) produced medium-sized fruits, all red and none with the fuzz, and as a whole inferior. The cross upon the male parent (62 x 178) 62 produced unusually large plants, with their fruit all red, smooth, medium large, fine-shaped and prolific. This was a very even lot of tomatoes and quite different from the reciprocal last mentioned. In the cross of the peach upon the cross 178 (62 x 178), the five plants were all late in maturing their fruit, which was without the fuzz and in color and shape a fine, red plum. The fruits were in large clusters, all nearly alike and produced in great abundance. Of the reciprocal (62 x 178) 178, there were only two plants, and they produced plants of the peach type.

The "Ignotum-Red Plum" Family.

The cross of the "Ignotum" and "Red Plum," in its second generation, produced standard, fine-leaved plants, with fruit varying from a good-sized to a large, red plum. The male parent upon the cross 62 (62 x 180) gave very large, long plants, with red fruits, some of the large plum type, while other plants bore a good, medium tomato in enormous clusters. One cluster had nine ripe fruits at one time. The reciprocal (62 x 180) 62 gave the same results. When the plum was bred upon the cross 180 (62 x 180) plants with quite uniform fruits resulted, all of them being of a large plum type and very productive. The reciprocal (62 x 180) 180 produced uniformly the plum type and nearly the same as the last, but wonderfully prolific. In case of the need of a good-sized, plum-shaped fruit, this combination would seem to be very desirable.

Time and space admit of only a few general remarks concerning the results when the "families" are not fully represented.

It was impossible to have the plants ready for setting at the same time, and the question of comparative earliness must be left for future tests to determine. The young plants were set out from March 25th to as late as the 15th of May, and it is not fair to compare varieties as to relative earliness unless they are grown during the same dates. A week in June is worth more than the same time in April. Many points of a general nature were, however, recorded as to the behavior of the plants. For example, the crosses between "Acme" and "Bright and Early" are undoubtedly early, and some of them good-sized fruit and very prolific. In those combinations where the "Bright and Early" is three-fourths, the results indicate that a good tomato for forcing may be in sight. By breeding the "Earliana" with "Bright and Early" a better fruit is obtained than in either parent. The "Earliana" loses somewhat in size, but its shape is improved and there is a better ripening at the "shoulder," with less inclination to crack.

The "Magnus-Crimson Cushion" crosses are full of promise, because of the large, vigorous vines and exceptionally fine fruits. The two parents do not blend as thoroughly as in many instances, and two types in both character of leaf and also of fruit are apparent—that is, there are the coarse and fine-leaved and the red and the pink sorts, besides the tendency of the "apple" shape of the "Magnus" and the more flattened form of the "Cushion" to be in evidence. It is this combination that shows a strong tendency to a marked reduction in the number of seeds, and in the greenhouse plants the fruits were often seedless. Slice-view of a fruit is shown at 7, in Plate V.

The "Arcadia-Cumberland" combinations gave prolific plants with remarkably bright red fruits of desirable size and shape.

In the "Arcadia-Earliana" crosses the most prominent feature was the earliness, with the fruits quite flat and smooth. The plants quickly became prostrate and the crop was gone before neighboring crosses were in full fruitage. Somewhat opposite to this resulted from the "Stone-Earliana" combination, but here there were two types among the crosses, the one favoring the "Stone," with fine, apple-shaped fruits with a long season, and the other flat-grooved with an early short season, like the "Earliana."

The "Stone-Favorite" crosses gave a good showing of fine, smooth fruits, thirteen plants bearing red and six pink tomatoes. Aside from these two types in color there were other indications, as variable size of plant and fruit, that much selection will be necessary to fix the desirable qualities. Slice-view of a fruit is shown at 2, in Plate V.

The "Honor Bright-Fortune" plants were set late, but they gave a large yield of remarkably fine, smooth fruits that were with thick, firm walls, and no doubt of high shipping and keeping qualities. The double cross with three-fourths of the "Honor Bright" "blood" showed four of the five plants with yellow foliage, with fruit that passed through the "white" conditions on the way to the mature red. Similar results were obtained in the "Honor Bright-Freedom" combination, where three out of ten of the thirteen plants were with yellow foliage and the white, immature fruit. There is a strong objection to the foliage, being of a color to suggest that some disease is sapping the life of the plant. Such plants in these crosses, however, gave a good yield of fruit of fine quality. Slice-views of fruits are shown at 3 and 4, in Plate V.

The "Giant-Frogmore" crosses gave very large plants with irregular, flat, red fruits, with the core inclined to be solid and greenish. When the "Giant" was the female, as in the "Crimson Cushion-Giant" combination, the results were somewhat similar. In short, the "Giant" seems to have great power in producing strong plants that are long in bearing and produce a large, "meaty" fruit that, while of special value for the canneries, may not be otherwise desirable. However, out of these crosses it is probable that a variety with a large, smooth and solid fruit may be secured. Slice-view of fruit is shown at 5, in Plate V.

The "Crimson Cushion-Marvel" crosses were limited to fifteen plants of three combinations. In the original or half-blood union the plants were large and prolific of large, smooth fruits. Two types were manifest—the "apple" of the "Marvel" and the flattened form of the "Cushion." The color was bright red, and the number of seed cavities reached as high as twenty, with few seeds. The row of three-quarter "Cushion" blood gave large plants with nearly smooth, large, red fruits, recorded in the note-book as "prolific * * remarkably fine." The corresponding row of three-quarter "Marvel" blood produced very strong plants, bearing large red, nearly smooth fruits, with note-book remark: "One of the best rows in the field." Whenever either of these two parents has been in combination good results have obtained. Those with "Ponderosa" are given elsewhere under the "Ponderosa-Marvel" family.

In the "Stone-Michigan" cross a very even lot of thrifty plants was obtained with medium large fruits of a bright, cherry-red color and exceedingly uniform in size, inclined to the "apple" form." The "Stone-South Jersey" combination was less uniform than the last, owing to the great dissimilarity of the two parents. The very irregular fruit of the "South Jersey" was not overcome, but greatly improved by the "Stone," giving a flat fruit that was nearly smooth and little ribbed at the stem end. When the "Stone" blood was increased to three-fourths by breeding "Stone" upon the cross, the fruits became smooth, but the plants were not prolific. There was quite a difference between the reciprocals here, for the cross upon "Stone" produced irregular fruits in great abundance, suggesting a good type for truckers to grow for the canneries, as the fruits, while large and rough, were very solid. It is quite certain that five plants are not enough from which to form an opinion of the worth of any cross, much less to decide upon the effects of reciprocal breeding.

Of the "Ponderosa-Sutton's Best of All" cross there were only the cross itself and the "Ponderosa" bred upon this cross. The first gave all red-fruited plants, while the latter three red and two pink. It was evident that the pink-fruited plants were quite close to the "Ponderosa" in other points. The red fruits were inclined to crack upon the shoulder.

The "Dwarf Stone-Golden Queen" cross brought together two types of tomatoes (1) as to size of plant and (2) color of fruit. There were two sets of this cross—that is, between the two varieties from different seedsmen and of the thirty plants, twenty-five were standard and five dwarf. Of these, fourteen were red and six yellow, and two sets of five each of an orange color, as if the two colors had blended. The last made up the two rows where the "Dwarf Stone" was bred upon the cross, in which there were eight standard and two dwarf plants. The cross as a whole was not productive.

The "Aristocrat-Golden Queen" was a case similar to the last, with seventeen plants in four combinations, in which there were five pink (two pink-orange), five yellow and seven that were a blend. The plants were a small standard and as a whole undesirable. The original "Aristocrat" of this cross, the seed of which was purchased in 1903, is red-fruited and resembles the "Dwarf Champion."

The Lemon Blush-Aristocrat" cross again brought standard yellow and dwarf pink into combination, of which there were thirty-two plants, all standard, in two sets, with the following display of colors: Red, one; orange-red, one; reddish pink, four; yellow, six, and twenty of a blend—that is, a pink with a strong showing of yellow. The yield was not satisfactory as a rule. In the "Lemon Blush" is remarkable vigor of plant, which shows itself prominently in all its crosses.

In the "Dwarf Stone-Aristocrat" cross there were twenty plants, all dwarf and red-fruited, as expected, but the plants, without exception, were stunted and quite unproductive.

The "Lemon Blush-Dwarf Champion" cross is another combination of a standard yellow with a dwarf, pink-fruited sort. Of the twenty-one plants, there were eighteen standard and three dwarfs—four red, two dull red (a blend of pink and red), ten pink and five yellow. One pink and two dull red made up the three dwarfs.

The "Dwarf Stone-Extra Early Tree" cross had twenty plants, of which fourteen were standard and six dwarfs and all red-fruited, with the exception of one yellow. The tomatoes were uniformly large, smooth and usually with a long axis, but not produced in abundance. Two showed the "Mosaic" foliage and a mottling of the fruit.

In the "Crimson Cushion–Sumatra Fig" cross the type and color of fruit differed in the parents. The fifteen plants gave twelve red and two yellow, with a remarkable range of variation in the size of the fruits. Thus in the simple cross of four plants there were two with medium-sized, flat, angular fruits and two of a large plum type and a strong indication of yellow. When the large, red-fruited parent was bred upon the above cross one plant produced large, flat-ribbed tomatoes, one large, long "plums" and the others were intermediate. Upon the other hand, when the "Fig" was three-quarters, the six plants—three red and three yellow-fruited—produced "plums," but varying much in length. The "Cushion" fruit showed somewhat in only one of the plants.

Among the double crosses it is noted that when the "Ignotum-Red Plum" was bred upon the "Magnus-Ponderosa" the five plants were all standard, fine-leaved, and four with red and one with pink fruits. The large vines were enormously productive of large plum fruits. The "Red Plum" seemed to be able, in this combination, to control the size quite fully.

A double cross between "Magnus-Ponderosa" upon "Currant-Stone" gave plants all showing the "Currant" foliage strongly present, that bore abundant red "cherry" fruits, variable in size and undesirable save for pickling.

The "Currant-Stone" was bred upon "Earliana-Fortune," and there resulted extremely "viney" plants that bore a large, red "plum" fruit. Practically the same result was obtained with "Ignotum-Red Plum" upon "Earliana-Fortune." The two double crosses were easily distinguished in the foliage. A single small-fruited sort is able to show a controlling power over three of the large-fruited sorts, the size of which has been acquired by selection, etc.

One plant of the three grown of the double cross of "Magnus-Ponderosa" upon "Dwarf Stone-Extra Early Tree" produced remarkably fine red, smooth, apple-shaped fruits, from which there is hope of developing a tomato with exceptionally long axis, combined with good size.

A double cross of some interest was that of the "Aristocrat" (149), with red fruit, upon the cross of "Lemon Blush" (147), a yellow fruit tinged with red, and the "Dwarf Champion" (153), having a pink fruit. In the first place, all five of the plants were standards, approaching the "Lemon Blush" type in size and vigor, and the fruits, as judged by the color chart, were a pure orange in some instances, and all were of that color upon the shoulder, with admixture of red toward the blossom end.

Second Generations Only.

In the following the second generation only were grown—that is, there was no crossing of either parent with them:

"Freedom/King Humbert" (54/64).
"Ignotum/King Humbert" (62/64).
"Marvel/King Humbert" (77/64).
"3151/King Humbert" (3151/64).
"3151/Yellow Pear" (3151/185).
"3151/3147."

The following first crosses were grown:

"Stone/South Jersey" (122/119).
"Currant/Golden Queen" (177/144).
"Red Plum/Golden Queen" (180/144).

Plate V. shows specimen fruits in sectional view of twelve different crosses. The card bearing the record fractional number is a one-inch square, from which the size may be judged. No attempt was made to select more than an average fruit, and they were taken quite late in the season, after the plants had passed their prime. At 1 is the double cross of "Fortune-Earliana" upon "Earliana," showing that the center is thoroughly broken; 2 is "Stone" upon "Stone-Favorite," in which the center is still more divided up into small seed cavities. At 3 is "Honor Bright-Fortune" upon "Fortune"—an oblong fruit with an excellent interior, while 4 shows one of the same cross with three-fourths of "Honor Bright" "blood." Number 5 is "Giant-Frogmore," and 6, "Honor Bright-Frogmore." At 7 is a view of "Magnus-Crimson Cushion" cross—a large fruit with a meaty center, and number 8 gives a small specimen of "Ponderosa-Marvel." A view of "Mikado-Princess" is given at 9, and a second generation fruit of "Magnus-Ponderosa" at 10, with the third generation at 11. An "Acme-Stone" view is seen at 12. In order to bring out the parts more distinctly, the slices were permitted to dry somewhat, so that the pulp has shrunken from the walls a little.

List of the Crosses Grown in 1905.

Below is given a list of the crosses of tomatoes grown in the Gardens during the season of 1905.

The first column gives the crosses all in their second generation, and the other upright lines indicate the form of the breeding of the cross with the parents. Thus, in the second column, it is the male parent upon the cross, indicated by the letters m. p. over x $\left(\frac{m.\ p.}{x}\right)$ The middle column is the cross upon the male parent, as shown in fractional form by the signs $\frac{x}{m.\ p.}$., and the fourth and fifth columns deal with the combination of the cross with the female parent (f. p.) in reciprocal.

Primary Cross.	Male Parent Upon Cross. m. p.	Primary Cross Upon Male Parent. x	Female Parent Upon Cross. f. p.	Primary Cross Upon Female Parent. x
“Arcadia/Acme” (4/2)	x	m. p.	x	f. p.
“Acme/Arcadia” (1/5)	“	—	“	“
“Acme/Bright and Early” (2/14)	“	—	“	“
“Earliana/Bright and Early” (37/14),	“	“	“	—
“Magnus/Crimson Cushion” (75/26)	“	“	“	—
“Arcadia/Cumberland” (4/28)	“	—	“	“
‘Arcadia/Erliana” (4/34)	“	—	“	—
“Stone/Earliana” (121/36)	—	—	“	“
“Stone/Favorite” (121/49)	“	—	“	“
“Earliana/Fortune” (33/53)	“	—	“	—
“Honor Bright/Fortune (60/53)	“	—	“	“
“Earliana/Freedom (33/54)	“	—	—	—
“Giant/Frogmore” (56/55)	“	—	“	“
“Honor Bright/Frogmore” (60/55)	“	—	—	—
“Crimson Cushion/Giant” (26/55)	“	—	“	“
“Crimson Cushion/Marvel” (26/77)	“	—	“	“
“Ponderosa/Marvel” (103/77)	“	“	“	“
“Crimson Cushion/Matchless” (26/81);	“	—	—	—
“Crimson Cushion/Mayflower” (26/83),	“	—	—	—
“Potato Leaf/Michigan” (104/85)	“	—	“	“
“Stone/Michigan” (123/85)	“	—	—	“
“Potato Leaf/Minnesota” (104/87)	—	—	“	“
“Magnus/Ponderosa” (75/103)	“	“	“	“
“Mikado/Princess” (89/109)	“	“	“	“
“Stone/Quicksure” (121/110)	—	“	—	“
“Stone/South Jersey” (123/119)	“	“	“	“
“Acme/Stone” (1/121)	“	—	“	—
“Currant/Stone” (177/122)	—	“	“	—
“Ponderosa/Sutton's B. A.” (103/128),	“	—	—	—
“Currant/Sutton's B. A.” (177/128),	—	“	—	“
“Red Pear/Wonder” (179/141)	“	“	“	“

Primary Cross.	Male Parent Upon Cross.	Primary Cross Upon Male Parent.	Female Parent Upon Cross.	Primary Cross Upon Female Parent.
"Quarter Century/1903" (165/143)...	"	—	"	"
"Df. Stone/Golden Queen" (170/144),	"	"	"	—
"Aristocrat/Golden Queen" (151/145),	"	—	"	"
"Df. Stone/Golden Queen" (169/145),	"	—	—	—
"Lemon Blush/Aristocrat" (147/149),	"	—	"	—
"Lemon Blush/Aristocrat" (147/150),	"	"	—	"
"Df. Stone/Lemon Blush" (171/150),	"	—	"	"
"Lemon Blush/Aristocrat" (147/152),	"	—	"	"
"Df. Stone/Aristocrat" (171/152).....	"	—	"	—
"Lemon Blush/Champion" (147/153),	"	"	"	—
"Df. Stone/Champion" (171/153)....	"	"	"	"
"Atlantic Prize/Champion" (6/154)..	—	"	—	—
"Lem. Blush/Champ. Scar." (147/156),	"	—	—	—
"Champion/Champ. Scar." (153/156),	"	—	—	—
"Champion/Dandy Dwarf" (153/158),	"	—	—	—
"Stone/E. E. Tree" (171/159).......	"	—	"	"
"Champion/Quar. Cen." (153/165)..	"	"	"	—
"Sta. Yellow/Df. Stone" (210/169)..	"	—	"	—
"Red Cherry/Currant" (176/177)....	—	—	—	—
"Red Peach/Currant" (178/177).....	—	—	—	—
"Yellow Cherry/Currant" (183/177)..	—	—	—	—
"Ignotum/Red Peach" (62/178).....	"	"	"	"
"Ignotum/Red Plum" (62/180)......	"	"	"	"
"Crim. Cushion/Sum. Fig" (26/181)..	"	—	"	—
"Ponderosa/Sumatra Fig" (103/181)..	"	—	"	—
"Crim. Cush./Yellow Pear" (26/185)..	"	—	—	—
"Earliana/Yellow Peach" (37/186)...	"	—	—	—
"Potato-leaf/Yellow Plum" (104/187),	"	—	—	—

Novelties or Varieties Not Before Grown in the Gardens.

All the varieties are of the standard, fine-leaved type, excepting No. 191, which is a dwarf, and No. 195, which is of the "currant" type.

No. 188. "Alice Roosevelt." Plants without much vigor and productiveness. The fruits are red, smooth and medium-sized, with a tendency to be somewhat pineapple-shaped.

" 189. "Baltimore." Plants medium and fruits large, smooth, but much flattened.

" 190. "Buist's Beauty." A heavy bearer of large, nearly smooth, bright red fruits. This is one of the most promising of the list.

" 191. "Burbank's Pickling." This is a dwarf with the foliage closely set and coarse. The fruit is very small, like the "cherry" type.

" 192. "Cluster." The plants soon become prostrate and the fruits, in clusters, lie upon the ground. The fruits are red and quite irregular and flat. The yield is, however, large and early.

No. 193. "Comrade." The red fruits, while many, were only medium to small in size.

" 194. "Globe." Liv. This had the finest fruits of the list, which were a fine pink and large and long. The yield was neither large nor early.

" 195. "Grape." There seemed to be no distinction between this and the "currant" type, and, therefore, was of no special value.

" 196. "Hawkins' Sunrise." This, while early, yielded medium large, red fruits, which were quite irregular and undesirable.

" 197. "Hustler." Here was a variety that showed some earliness, but the red fruits were irregular and small.

" 198. "I X L." This was one of the first to produce ripe fruits, which were red and of medium size. Inclined to decay.

" 199. "Majestic." It was one of the late sorts with red fruits, being smooth, large, but subject to decay.

" 200. "New Century." The fruits (red) were medium, somewhat irregular and fairly early.

" 201. "Pioneer." This gave a pink fruit, of medium size, in fair quantity.

" 202. "Presto." Here was a smooth, small, red-fruited sort, that yielded well.

" 203. "Prize Belle." A very variable set of plants, mostly with medium small, red fruits.

" 204. "Radium." This was a medium late, pink sort, that was not up to the average.

" 205. "Red Cross." A medium small, red-fruited variety, of fair yield, but rotted badly.

" 206. "Redfield Beauty." This was a sort that produced pink fruits, of fair size, that rotted badly.

" 207. "Tenderloin." A late sort that did not show special merit.

" 208. "Boston Market." This gave irregular, red, early fruits, of medium size.

" 209. "Puritan." A few fruits were produced through a long season.

" 210. "Station Yellow." This variety was assigned a number at the end of the list.

Two additional numbers were added late in the spring:

No. 211. "Puget Sound Special." Through the kindness of Mr. W. D. Ennis, a packet of seed of the tomato named above was obtained. Under the very trying conditions for growing tomatoes in the far Northwest, this local variety did much better than any other sort. In our Gardens the plants were of the dwarf type and made less vine and fruit than almost any other kind among which they grew. The fruits were of fair size and smoothness.

No. 212. "Washington." The seed of this tomato was kindly sent to the Experiment Station by its originator, Professor C. A. White, of Washington, D. C., and ten plants of it were grown in the Gardens, with 212 as its list number. The seed was not received in time to be sown with the other novelties, and therefore the plants were late in coming into bearing. The "Washington" produced a small plant with the strictly dwarf or upright habit, bearing closely-set leaves of the kind commonly met with upon dwarfs, as those of "Aristocrat" or "Champion." The flower clusters were unbranched and the fruit of good size, being pink in color and comparatively smooth, with the center broken and the seed cavities, six or more, like the "Acme," which has a somewhat smaller fruit. The wall is thick and the whole fruit quite closely resembles that of the cross between "Magnus" and "Dwarf Champion." None of the ten plants yielded well. Some crosses were secured particularly with the "Acme," and a quantity of seed was saved from hand-worked flowers.

The First Picking of Tomatoes, July 14th, 1905.

No. 4. "Arcadia." Two fruits, very small, flat.
" 34. "Earliana." Four fruits, large, not cracked, good shape.
" 42. "Early Ruby." Eight fruits, fair size, flat, irregular, not cracked.
" 65. "King of the Earlies." Four fruits, fair size, flat, irregular, not cracked.
" 77. "Marvel." Two fruits, fine shape, smooth, one of the best.
" 89. "Minnesota." Three fruits, small, long, suggestion of peach "blood."
" 94. "Noltes' Earliest." Seven fruits; very irregular in shape and size; one had good length, size and shape.
" 119. "South Jersey." Two fruits, inferior in all things excepting color.
" 188. "Alice Roosevelt." Three fruits, cone-shaped, good size and color, some signs of cracking.
" 198. "I X L." Two fruits, very irregular and inferior.
" 200. "New Century." Three fruits, cone-shaped, good size, poor color, resembles "Alice Roosevelt."

"Seedless" Tomatoes.

During the present season twenty-five plants were grown of the so-called "Seedless," which is a tomato that came to light originally among a plot of plants that were a cross of "Golden Sunrise" upon the "Dwarf Champion," made in 1899. It was at the outset remarkable for its great size, and was called the "Giant" on that account. The seedlings frequently bear three cotyledons, and the plants are very slow, growing long-stemmed, with the foliage open, due to the long internodes, and leaves with the divisions widely separated, which are crinkled, and the terminal leaflet blunt-pointed. The flower clusters

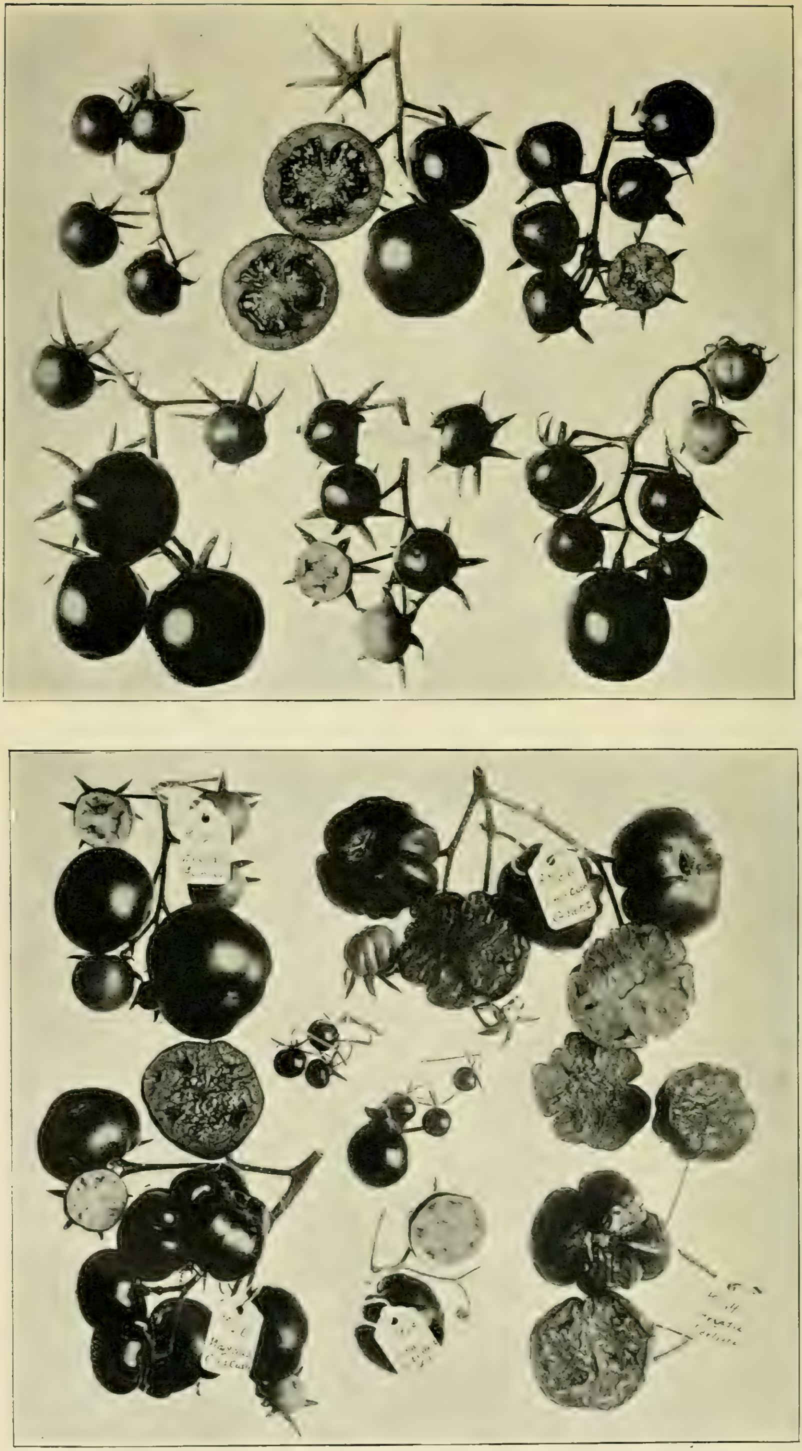

PLATE VII.

Several crosses grown in greenhouse, showing Seedless Mature Tomatoes and some that were normal. The labels are three-fourths inch wide.

are small, flowers cup-shaped, light lemon-yellow, and the fruits few, medium small, light yellow and nearly seedless. The flesh is particularly fine flavored. The plants, three feet apart each way, covered the ground devoted to the block, and flowered up to the killing frosts near November 1st.

The plants of this season were not unlike those of previous years, and the type seems to be well fixed. All attempts to cross any other sort upon it have uniformly failed, and the only way to get a half-blood seems to be by using this one as the pollinator. Two plants were grown in the greenhouse last winter for this purpose, but no crosses were obtained upon it or with it upon other varieties.

There was another type of seedlessness met with in the greenhouse that is illustrated in Plate VII. It was first observed that certain young fruits of the hybrid of "Currant" upon "Stone" ceased to enlarge and began to turn of a pale green, while others in the long, slender cluster continued to grow until several times the size of the first mentioned. The color and size of the little fruits were so nearly those of peas somewhat too old for eating that the name "Pea" tomatoes was given to them. In time all the fruits upon a cluster, whether of the size of peas or cherries, ran through the ordinary color changes until they were of the tomato-red, or ripe, condition. The knife reached the truth of the supposition in each case of the small fruit, for they were invariably seedless, and the flesh filled up the interior, with perhaps a small, empty seed cavity.

The same thing was met with later on, when the cross of the "Crimson Cushion" upon "Sumatra Fig" came into bearing. The upper part of Plate VII. shows some of the clusters of this combination between a large and small-fruited variety. Near the middle of the group, where the label—about an inch long—is situated, the whole cluster is of the small, seedless sort. They were all ripe—that is, of a red color—excepting the terminal one. A section through one of the fruits shows that with these there are three cavities well toward the center of the solid flesh. The clusters to the right and left show the size of the seedless, as compared with the seed-bearing fruits, when both are of the same color of maturity. The seedless fruits obtained a certain uniform size that did not differ but slightly from their average. In short, upon these plants there were two distinct sizes of fruits, the one seed-bearing and the other seedless.

The lower portion of the plate shows instances of seedless fruits that were met with upon other crosses. The "Crimson Cushion," in its combination with "Giant" and "Magnus," gave many seedless fruits that were large enough for the table, being over two inches in diameter. "Arcadia" with "Acme" and with "Earliana" are other crosses with seedless fruits that are shown in the plate. In the middle of this portion of the plate is shown a cluster of the "Currant-Stone" cross with the "Pea tomatoes" and one of normal size. The sectional views of the fruits give an idea of the solidity of the flesh. A practical test of the quality indicated that a tomato may be seedless and still have a superior flavor, but it may, however, be somewhat different from that of the ordinary tomato. In two instances, when they were being tested by unbiased persons and in connection with different lots of these seedless fruits, it was remarked that they had the flavor of strawberries.

The conditions surrounding these plants favored non-pollination and yet stimulated the growth of the flesh of the fruit, and it is assumed that the withholding of the pollen is the primary cause of the peculiar dwarfed fruit above considered. That some varieties produce seedless fruits more readily than others seems a fact, and it will be remembered in the breeding for more flesh and less seeds in tomatoes.

A large number of cuttings were made from the "Magnus-Crimson Cushion" cross that was prominent in its number of seedless fruits and set in the Gardens, where a row of remarkably uniform plants grew and fruited profusely. There were no signs of the small, seedless fruits, although they were frequently looked for. The conditions of the open field seemed to overcome the peculiar tendency so apparent in the greenhouse.

Tomato Plants Transferred from Greenhouse to Field.

The following is a record of a block of tomato plants taken from the greenhouse, where they had borne fruits during the winter, to the Gardens, and grown there for the summer season. The plants were cut back to within a few inches of the soil and permitted to send up small shoots before they were removed from the large pots to the Garden plot.

Upon September 5th the vines were cut near the ground and the following record, showing cross by fraction, was made:

1. $\frac{121}{36}$ produced a small vine with sixteen irregular fruits of medium size.
2. $\frac{4}{34}$ gave a very small plant, bearing only four poor fruits.
3. $\frac{4}{14}$, a small plant with twenty-five very small fruits.
4. $\frac{2}{14}$, a medium plant with forty-five very small fruits.
5. $\frac{1}{5}$, very small plant, bearing twelve medium fruits.
6. $\frac{33}{53}$, medium plant with forty fine fruits.
7. $\frac{121}{49}$, a large plant and fifty fine fruits.
8. $\frac{75}{26}$, plant large and thirty good fruits.
9. $\frac{103}{77}$, small plant and ten small fruits.
10. $\frac{26}{77}$, a medium plant with eighteen large fruits.
11. $\frac{26}{56}$, medium plant with twenty large fruits.
12. $\frac{60}{54}$, a large plant and one hundred medium fruits.
13. $\frac{104}{87}$, a very small plant with ten medium fruits.
14. $\frac{123}{85}$, plant very large and a large number of green fruits.
15. $\frac{26}{83}$, a large plant with fifty good late fruits.
16. $\frac{26}{81}$, plant large, with seventy fine fruits, nearly all green.
17. $\frac{103}{128}$, very viney plant with thirty-five medium fruits.
18. $\frac{89}{109}$, a large, coarse-leaved plant, with forty large fruits.
19. $\frac{147}{150}$, very large plant with ninety good-sized fruits.
20. $\frac{147}{149}$, a medium plant with forty fruits.
21. $\frac{169}{145}$, a large plant with forty medium fruits.
22. $\frac{170}{144}$, small plant and thirty medium fruits.
23. $\frac{147}{156}$, very large plant with a hundred large, mostly green fruits.
24. $\frac{6}{154}$, a medium plant with twenty-five fruits.
25. $\frac{147}{153}$, a medium plant, but with fifty large fruits.
26. $\frac{171}{159}$, a large plant and fifty large fruits.
27. $\frac{153}{158}$, medium plant and twenty medium fruits.
28. $\frac{153}{156}$, medium dwarf with thirty fruits.
29. $\frac{75}{103}$, two plants, large, with seventy fine, large fruits.

The block of transferred plants looked fully as well, in all respects, as those from seeds grown in adjoining plots. An opportunity was offered to make a comparison of the size and structure of the fruits grown upon the same plants in the greenhouse and in the open, and the conclusion is that the superior conditions the Gardens afforded resulted in larger vines and fruits. There was practically no change in the general shape or internal structure of the fruits. The greenhouse fruits are smaller and less irregular than those upon the same plants in the open. In other words, a fruit that is medium large in the open may be expected to be medium in the greenhouse, and one that runs a good, fair size out of doors may possibly be under size under glass. However, a smaller fruit will sell better in the forcing season than when the garden crop is marketed.

Narrow-Leaved Tomato Plants.

Among the three hundred and more crossed plants grown in the greenhouse last winter there was one that, during its later stages of growth, showed leaves with their expansions reduced to long, narrow threads, and not much wider than the midribs. During the past season several of the field plants have shown the same reduction in the foliage, thus giving a peculiar appearance, resembling somewhat that of certain ferns. Such plants are not usually as vigorous as the normal type of the cross in which the slender-leaved form appears. It is not confined to any group of tomatoes, but was met with in both "dwarfs" and "standards," and the "fine" and "coarse-leaved" sorts. As in the single case met with in the greenhouse, the slender form (filiform) does not appear until one or more of the normal leaves have developed. By the time blossoms appear the filiform foliage is in evidence and continues until the close of the season. Crosses with the "Currant" and other small-fruited sorts seem to show more of this abnormality or unusual form than elsewhere. The plants are not fruitful, but close-bred tomatoes were secured to test the stability of this type of foliage in succeeding generations. It may be one of the mutants, that, while interesting as such, does not seem to possess a desirable form of leafage.

Yellow Foliage in Tomatoes.

Certain varieties of tomatoes, as the "Grandus," Honor Bright," "Multicolor," "Princess" and "Dandy Dwarf," have a characteristic yellow foliage, correlated with "white" fruits, which finally turn to the ordinary color upon maturity. Three of these with yellow foliage and "white" fruits are among those that have been crossed, and it may be of interest to give some observations upon the behavior of the above characteristics when bred with the ordinary sorts.

"Honor Bright" was bred with "Fortune," and four out of fifteen plants were yellow: with "Freedom," and three of the fifteen were yellow; with "Frogmore," and one of the ten was yellow. The "Princess" was bred with "Potato Leaf," and four of the twenty plants were yellow. "Dandy Dwarf," with "Dwarf Champion," gave three yellow out of ten plants. In short, out of seventy crossed plants there were fifteen with the "white" fruit and yellow foliage.

In the five cases where the cross showed three-quarter "yellow" blood, there were eleven out of the twenty-five plants with the yellow foliage, and among the six sets (thirty plants) of quarter-yellow blood there were only two of the yellow plants. The two sets of half-bloods showed two out of the ten plants with yellow foliage.

These figures indicate that the yellow character is possibly Mendelian, but it seems to increase as the amount of the blood of the yellow plant is greater and decreases as it is diminished.

Unit Characters Among Tomatoes.

In view of the discoveries of Mendel and others along lines of plant breeding, it may be stated that the work with tomatoes has led to the opinion that there are a number of characteristics among them that follow more or less closely the laws governing the behavior of so-called unit characters.

Starting with the whole plant, is is found that the standard and dwarf types are antagonistic and Mendelian, the former being the dominant character. The same is true of the fine and coarse-leaved (potato) types, the fine dominating over the latter. The yellow foliage, as against the ordinary green type, may be a recessive character, as illustrated in several crosses that have been grown in the Gardens the present season.

In color of fruit the red and yellow follow the law, the red dominating, and the same is true of the pink and the yellow. When the red and pink are bred together the red dominates less evidently.

The characteristic hairiness of the "peach" fruit seems to be antagonistic to that of smoothness in the fruit and dominated by the latter. Thus, in a cross between "Ignotum" (62) and "Red Peach" (178), there were seventeen plants with smooth fruit and two of the true "peach" type.

It is seen that the following pairs in tomatoes seem to fall under Mendel's law of heredity, the dominant character being placed first:

Standard—Dwarf.
Fine Leaf—Coarse Leaf.
Yellow Leaf—Green Leaf. (?)

Red Fruit—Yellow Fruit.
Pink " — " "
Red " —Pink "

Smooth Fruit—Hairy Fruit.

"Mosaic" Disease Among Tomatoes.

Among the crosses of tomatoes there were certain plants which showed a mottled yellow in the foliage all through the season. As a rule, such plants did not flourish and rarely produced more than a few fruits. This trouble resembles the one by the same name in other kinds of plants, prominently the tobacco, and is likely due to a similar cause. The "Mosaics" were generally pulled out to lessen the liability of the trouble being communicated to other plants, but a close watch for it did not reveal it in any plants that were not marked with it soon after they were set in the field. The trouble may be quickly recognized by the angular patches of yellowish green, seemingly distributed without order in the ordinary green of the foliage. Such afflicted plants remain small and are comparatively worthless.

The following crosses showed this trouble in particular: "Arcadia" and "Bright and Early," "Champion" and "Champion Scarlet," "Dwarf Stone" and "Early Tree," "Champion" and "Quarter Century." It appears in the "standards" and "dwarfs," and "fine" and "coarse-leaved" sorts. Seed has been saved from badly-diseased plants with the view of determining whether the offspring of a diseased parent will show the "Mosaic" in particular abundance.

The fruits of "Mosaic" plants sometimes showed the peculiar markings all through their growth, and when mature the areas that lacked the green had a silvery appearance instead of the ordinary color of the fruit.

Color Changes in Ripening Tomato Fruits.

Five fruits, ranging from one the size of a cherry to full size and maturity, were selected from the several types of colors and examined with Prang's color chart. The following table gives some approximate results (Y stands for yellow; G for green; O for orange; R for red: D and L for dark and light, respectively):

Color of Mature Fruit.	Young Fruit.	Half Size.	Nearly Full Size.	Ripening Fruit.	Ripe Fruit.
Red	111 YG/DD	102 YYG/DD	52 O/D	52 O/D	42 ORO/D
"Pink"	105 YGG/LL		45 ORO/L	42 ORO/DD	32 RO/D
"Pink" (yellow foliage)	365? whitish.		"	"	"
Yellow.........	102 YYG/DD	115 YG/LL	94 Y/LL	95 Y/LL	83 YYO
"White".......	Color whitish all through—shade not given in the Prang scheme.				

It is seen that the fruits that become red at maturity are of a very dark green at the outset, and gain in yellow until nearing full size, when they become of a dark orange, which is held until near maturity, when the red is mingled with the orange. A "red" tomato is virtually more orange in color than red. It is a dark orange with a dash of red.

The "pinks" start with a light green, showing a little yellow, and the green is gradually replaced by the yellow, until when near full size the green disappears and the yellow is replaced by a light orange, showing a trace of red. From this time on the orange and red deepens until full maturity, when the fruit is a dark red orange. It differs from the so-called "red" fruit in having much more red and less orange. It is this type of fruit that deserves the name of red, while some other term might be given to the group that are more orange than red.

There is a group of tomatoes that is quickly distinguished by the light green or yellowish foliage, giving the plants the aspect of being sick, and in this respect objectionable. The "Grandus" and "Honor Bright" are examples of this among the fine-leaved, and the "Princess" and "Dandy Dwarf" among the coarse-leaved sorts. The fruits here.

while indistinguishable when very small from the ordinary kinds, soon lose the green, as in the foliage, and become whitish, and with some yellow mixed with it remain without much color until full sized, and then run through the color changes to the "red," in "Honor Bright," for example, or the "pink" in "Grandus" and "Princess."

The "peach" is not so green as the first two types when the fruit is quite small, and all through there is a mottled appearance, that, together with the fuzz, makes it difficult to record the color value. When mature the "peach" is practically a "red," "pink" or "yellow," as the case may be, the hairy surface modifying the appearance somewhat.

The yellow group, as might be expected, loses the green in the fruit early in its growth, and, in short, has the color strongly yellow when the size of a cherry. The plain light yellow, unmixed with other color, holds until nearing maturity, when a distinct orange comes in. The amount of this orange varies with the variety and the situation. Some sorts are a lighter yellow than others, while exposure to sun seems to increase the orange—that is, fruits that are thoroughly shaded are a pale yellow, while others upon same plant and fully exposed may be quite orange-colored. In like manner there is a tendency in the yellow-fruited sorts to the development of a red when the fruits have become fully matured in the open sunshine. As with peaches, the side of the yellow fruit that is most exposed is the most highly colored. When the fruit is a "red" or "pink" this difference due to sunshine is not so apparent.

The last group to be mentioned is a small one, represented by such sorts as "Ivory Ball" and "White Apple," which seem to be deficient in the ordinary color pigments, and, starting with a small amount of green, quickly lose it and remain of a pale white until mature.

The following are the running notes upon a lot of "Magnus-Ponderosa" tomatoes of the same age:

March 31st.—Changed from lighter yellowish green (115 YG/LL) to darker yellowish green (101 YYG/DD) on April 1st and until the 5th inst., when the color was changed one point by becoming less dark (102 YYG/D). Upon the 8th orange appeared with the score 72 (YO/D), and upon the 9th the orange was much increased, namely, 62 (OYO/D). Upon the 14th the fruits were dead ripe and the score was 22 (RRO/D). In other words, the green was succeeded by yellow and the yellow by orange, and last, red was added to the orange.

A group of "Station Yellow" crossed with "Dwarf Stone" ran from the dark yellow green quickly into the orange, they being a pure dark orange for one day and then gradually took on red until they became a dark orange-red-orange, 42 (ORO/D) at maturity.

In a general way, the four scales may be expressed as follows:

1. Green. .Greenish-white. .Yellowish-white. ."White". . . . ."Ivory Ball."
2. Green. .Greenish-white. .Yellow-orange. . . .Orange-red. . . . . ."Honor Bright."
3. Green. .Greenish-white. .Yellow-orange. . . .Orange-red-orange. . . "Grandus."
4. Green. .Greenish-yellow. .Orange. . . . . .Orange-red-orange. . . . . . . "Stone."
5. Green. .Greenish-yellow. .Orange. . . . . .Orange-red. . . . . "Ponderosa."
6. Green. .Greenish-yellow. .Yellow . . . . .Yellow-orange. . . ."Golden Queen."

EXPERIMENTS WITH BEANS.

As a result of "handworking" the flowers among the commercial varieties, seventy pods were obtained during the early part of the season. Seeds from all of these were planted in July and all produced plants, with two exceptions. The absence of killing frosts until near to November 1st favored this summer planting and a majority matured seeds, and nearly all gave evidence of being crosses.

A block of bush beans was planted early in June with a dozen white-seeded sorts, and among these several pods were harvested as results from cross-pollination. Several probable crosses have also been secured between the three varieties (Nos. 155, 158 and 159) kindly sent by Mr. W. W. Tracy, Jr., and planted late in June.

A cross of the "Scarlet Runner" upon bush beans has been secured in several instances and promises to be of unusual interest. In this instance the blood of two species is brought together, namely, that of *Phaseolus multiflorus* and *P. vulgaris*. These hybrids have been grown only for midsummer planting, and a full trial of their power is reserved for next year. Thus far they have all showed a strong tendency to twine with flowers of a quite uniform pink, inclining toward salmon, in place of the bright red ("scarlet") of the male parent.

Like the "Scarlet Runner," its hybrids are profuse bloomers and quite slow to produce pods and form seeds. Such pods as were formed were much smaller than those of the male parent and lacked the roughness of the surface characteristic of the parent. Very late in the season a few pods from four plants were obtained, and these contained seeds that resembled the "Scarlet Runner" in being marked with red, but of much smaller size. It is not likely that this hybrid will prove of value as an edible bean, but it adds another color to the flowers of a thrifty, almost ever-blooming ornamental vine.

The efforts to cross the lima with the bush beans have been continued without results.

Notes upon Bean Crosses.

During the year four crosses of bush beans have been carried forward to their third generation, namely—*first,* "Bismarck" (102) upon "Detroit Wax" (113); *second,* "Jones' Stringless" (131) upon "Golden Eye" (130); *third,* "Davis' Kidney" (111) upon "Bismarck" (102); *fourth,* "Early Mohawk" (31) upon "Silver Bush" (38), and many crosses were carried through the second generation.

The first of the five crosses is expressed in the record-book by the fraction $\frac{102}{113}$—that is, the male ("Bismarck") is one of the black wax type, while the mother is of the golden wax group; the former is black-seeded and the latter is chiefly white, with a large, irregular brown "eye." On account of the color of their seeds the black wax beans are not as desirable as those with white seeds. While there may be no distinct difference in texture or flavor, the dark seeds give a discoloration to the pods, when cooked, that is not pleasing to the eye.

As there is no noticeable immediate influence (xenia) observed in these crosses, the first generation begins with seeds that are, so far as appearances go, the same as those of the mother plant. For example, the seed of the cross of "Bismarck" upon "Detroit Wax" is of medium size and white, with a large, brown eye, like the mother, and shows none of the black of the male parent. The plants of this first generation were medium tall, resembling the male parent ("Bismarck"), maturing early its long, straight pods. The seeds were dark mottled and of medium size, and were the beginning of the second generation of the cross. These plants showed much variation in size, some being quite tall and others short, while the flowers ranged from purple, like the "Bismarck," to white, as found in the "Detroit," and the pods varied from long in the male parent to short in the mother. At maturity three types of seeds were found, namely, plain black, dark

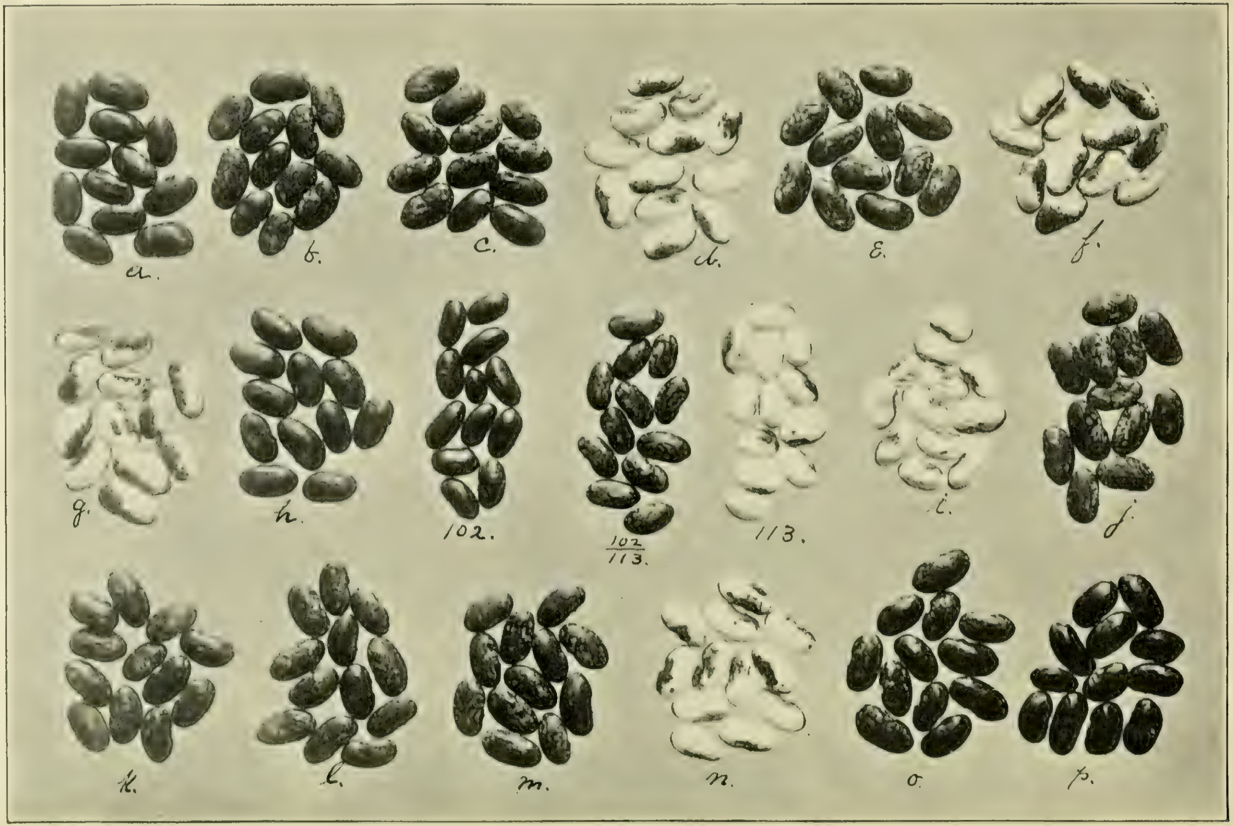
a.
b.
c.
d.
e.
f.
g.
h.
102.
102/113.
113.
i.
j.
k.
l.
m.
n.
o.
p.

PLATE VIII.

Beans from sixteen plants, *a* to *p*, and beginning the third generation of the cross of "Bismarck" (102) upon "Detroit Wax" (113). The parents are shown with samples of the seeds from the first generation between them in the middle of the group.

mottled and white with a dark eye. In other words, there are the two parent forms and an intermediate.

From the mottled seeds a row of sixteen plants was grown during the latter half of the present season, with the following results as to character of seeds, representing the third generation:

Plant *a*.	Seeds largely black, but somewhat mottled.
Plant *b*.	Seeds dark, but more mottled than the last.
Plant *c*.	The same as the last.
Plant *d*.	Seeds white, with the "eye" larger and darker than "Detroit."
Plant *e*.	Seeds dark indigo and mottled.
Plant *f*.	Seeds white with the indigo "eye" very large, covering a third of the seed.
Plant *g*.	Seeds pure black ("Bismarck").
Plant *h*.	Seeds white, same as *f*.
Plant *i*.	Seeds white, with small dark "eye" ("Detroit").
Plant *j*.	Seeds dark indigo and mottled.
Plant *k*.	Seeds almost entirely black, obscurely mottled.
Plant *l*.	Seeds same as last.
Plant *m*.	Seeds same as last two.
Plant *n*.	Seeds white, like *i*.
Plant *o*.	Seeds same as *m*.
Plant *p*.	Seeds a pure black.

A dozen seeds from each of the above plants, with the parents, are shown in Plate VIII.

This row of sixteen plants gives a record, as shown above, of two pure black, like the male parent ("Bismarck") and two of the "Detroit" type, with nine that are black (or indigo) mottled and three which vary from the mother type somewhat. Thus, *a, b, c, k, l, m* and *o* would not be distinguished from each other when mixed together, while *e* and *j* have the black replaced by an indigo. There is a suggestion in this small number of instances that possibly one-quarter of the plants in this cross will reproduce each plant and one-half the mottled or mixed form. In another row of the same cross the eleven plants gave one black, four dark-eyed and six mottled.

The next cross is recorded as $\frac{13}{130}$, namely, "Jones' Stringless" upon "Golden Eye." The male parent is of medium height and productive of straight, rounded, medium length wax pods, maturing early its plain white seeds. The mother has a larger, broader plant than "131." and bears flat seeds, distinguished by a yellow "eye." The first generation consisted of plants like 131 and the seeds were all mottled, of a grayish color. In the second generation there was much variation, some of the plants producing long, flat pods, others short and flat, while one had a neat, round pod. None of the seven plants produced seeds like the mother of the cross, but they were of four types, namely, (1) white, (2) dark brown mottled, (3) light brown mottled and (4) brown.

In planting for the third generation the dark brown type was inadvertently omitted. All of the plants from the white seeds produced only white seeds, and this indicates that with further generations from this stock no mixing of the brown color may be expected.

The cross of "Early Mohawk" upon "Silver Bush" bears the record fraction of $\frac{31}{38}$. The male parent ("Mohawk") has a large, stocky plant, medium early, with pink flowers, broad, long, flat green pods and dark mottled seeds, while the "Silver Bush" has a small-spreading plant, late in bearing, with white flowers and numerous small, round pods of a "silver" color, with small white seeds. The plant from this cross was of medium size, purple flower, and bore long, flat pods that became striped in maturity and produced good-sized, flat, dark mottled seeds. Some of the plants from this last-named plant—the second generation—showed a strong tendency to "run," and could easily have been classed as pole beans. Four of the "bush" type produced wax pods and black seeds. Two other types were present, namely, one with a light brown seed, having a few broad, dark streaks and a dark mottled sort. As yet this cross does not seem to be as prolific as either parent.

Notes upon Bush Beans.

The following table shows in condensed form many of the notes that were made upon the bush beans during the season of 1905:

No.	Kind and Source.	Size of Plant.	Flower Color.	Pod, Shape and Size.	Seed, Size and Color.	Season.
1.	"Best of All," Hlm	Medium	Pink	Long, flat	Medium, light mottled	Early.
2.	"Bountiful Bush," Hen	"	"	Medium, flat	Medium, brown	"
3.	"Boston Snap," Brk	"	White	Short, flat	Small, white	Late.
4.	"Breck's String and Shell," Brk	"	Pink	Medium, flat	Medium, brown mottled	Med. early.
5.	"Burlingame Medium," Brk	"	"	Medium, round	Dark brown	" "
6.	"Byer's Bush," Chl	"	"	" "	Medium, dark mottled	" "
7.	"Canada Wonder," Thr	Large	"	Long, flat	Large, red	Late.
8.	"Canada Wonder," Cox	"	"	" "	" "	"
9.	"China Red Eye," N. K	Medium	"	" "	Medium, dark eye	Med. early.
10.	"Crystal," Drr	"	White	Short, medium, round	Small, white	" "
11.	"Dwarf Chocolate," Thr	"	Purple	Long, flat	Small, dark brown	" "
12.	"Dun Colored," Thr	"	"	" "	" " "	" "
13.	"Eclair," Thr	"	"	" "	Small, light brown	" "
14.	"Earliest G. Pod," Ham	Large	Pink	" "	Medium, light mottled	" "
15.	"Emperor of Russia," Thr	Medium	"	Medium, round	Medium, dark mottled	" "
16.	"Emperor William," Hlm	"	White	Long, flat	Large, white	" "
17.	"Everbearing," Thr	"	"	" "	Medium, white	" "
18.	"Goddard Imperial," Fer	Large	Pink	" "	Medium, light mottled	" "
19.	"Horticultural Dwarf," Btl	Medium	"	" "	" " "	" "
20.	"Horticultural Dwarf," Hen	"	"	" "	" " "	" "
21.	"Horticultural," N. K	"	"	" "	" " "	" "
22.	"Early Marblehead," Fer	"	"	" "	" " "	" "
23.	"First on Market," Lan	"	White	" "	Large, white	" "
24.	"Land. Scarlet," Lan	"	Pink	" "	Medium, dark red	" "
25.	"Lightning," Thr	"	Striped	" "	Medium, light mottled	Extra early.
26.	"Longfellow," Hen	"	Pink	Long, round	Medium, mottled	Med. early.
27.	"Low's Champion," Ggy	"	"	Short, flat	Medium, dark red	" "
28.	"Marrowfat," Btl	Large	White	Long, flat	Large, white	Late.
29.	"Marrowfat," Hlm	"	"	" "	" "	"
30.	"Marvel of Paris," Thr	Medium	Pink	Long, round	Medium, dark mottled	Early.
31.	"Mohawk," Drr	"	"	Long, flat	Medium, mottled	Med. early.
32.	"Mohawk," Thr	Large	"	" "	" "	" "
33.	"Mohawk," Bru	Medium	"	Medium, flat	" "	" "
34.	"Prolific Tree," Iow	"	White	" "	Medium, white	Late.
35.	"Refugee," Btl	"	Purple	Long, flat	Medium, dark mottled	Med. early.

No.	Kind and Source.	Size of Plant.	Flower Color.	Pod, Shape and Size.	Seed, Size and Color.	Season.
36.	"Refugee Green," Bru.	Medium	Purple	Long, round	Medium, dark mottled	Med. early.
37.	"Silver," Sal.	"	White	" "	Small, white	" "
38.	"Silver Bush," Mau.	"	"	Short, medium, round	" "	" "
39.	"Stringless," Btl.	"	Pink	" " "	Medium, mottled	" "
40.	"Stringless Mammoth," Drr.	"	"	Long, round	" "	" "
41.	"Stringless Dwarf," Thr.	"	"	" "	" "	" "
42.	"Giant," Wd.	"	"	" "	" "	" "
43.	"Tennessee G. Pod," Fer.	Large	White	Long, flat	Medium, light brown	" "
44.	"Earliest R. Valentine," Hen.	Medium	Pink	Short, round	Medium, mottled	" "
45.	"Black Valentine," Hen.	"	Purple	Long, flat	Medium, black	" "
46.	"Stringless Valentine," Btl.	"	Pink	Long, round	Medium, mottled	" "
47	"Early Red Valentine," Btl.	"	"	Short, flat	" "	" "
48.	"Extra Early Valentine," N. K.	"	White	Long, round	" "	" "
49.	"Dwarf Prolific Pickler," Vk.	Large	Pink	Long, flat	Large, red	Late.
50.	"Warren Bush," Ggy.	Medium	"	Short, flat	Medium, red	"
51.	"Green Winter," Sal.	"	White	Short, round	Medium, white	"
52.	"Wonder of France," Brk.	"	"	Long, flat	" "	Med. early.
53.	"Yellow Six Weeks," Btl.	"	Pink	" "	Medium, light brown	Early.
54.	"Yellow Six Weeks," Bru.	"	"	" "	" " "	"
55.	"Light Yellow Six Weeks," Drr.	"	"	" "	" " "	"
56.	"Early L. Yellow Six Weeks," N. K.	"	"	" "	" " "	"
101.	"Burpee's Brittle," Bur.	"	White	Long, round	Medium, dark eye	Med. early.
102.	"Bismarck," Far.	"	Purple	Long, flat	Medium, black	Early.
103.	"Black Wax," Bart.	"	"	Medium, flat	" "	"
104.	"Black Wax," Bart.	"	"	" "	" "	"
105.	"Black Wax," Bru.	"	"	" "	" "	"
106.	"Black Wax," J. & S.	"	"	Medium, round	" "	"
107.	"Black Wax," Thr.	"	"	" "	" "	"
108.	"Black Wax," Thr.	"	"	" "	" "	"
109.	"Black Wax," Cur.	"	"	Medium, flat	" "	"
110.	"Cylinder," Hlm.	"	"	Long, round	" "	"
111.	"Davis'," Btl.	"	White	Long, flat	Medium, white	Med. early.
112.	"Davis'," N. K.	"	"	" "	" "	" "
113.	"Detroit," N. K.	"	"	Short, flat	Medium, dark eye	" "
114.	"Flageolet," Bru.	Large	Pink	Long, flat	Medium, red	" "

No.	Kind and Source.	Size of Plant.	Flower Color.	Pod, Shape and Size.	Seed, Size and Color.	Season.
115.	"Flageolet," Fer.	Large	Pink	Long, flat	Medium, red	Med. early.
116.	"Fullers' J. & S.	Medium	Purple	Medium, round	Medium, black	" "
117.	"Fullers'," Ggy.	"	"	" "	" "	" "
118.	"Golden," Btl.	"	White	Medium, flat	Medium, dark eye	" "
119.	"Golden," Bru	"	"	" "	" " "	" "
120.	"Golden," N. K.	Small	"	" "	" " "	" "
121.	"Golden," Cox.	Medium	"	Short, flat	" " "	" "
122.	"Golden," Hen.	"	"	" "	" " "	Early.
123.	"Golden," Fer.	"	"	Medium, flat	" " "	"
124.	"German Black," Fer.	"	Purple	Long, round	Medium, black	"
125.	"Golden Crown," Thr.	"	White	Medium, round	Medium, white	"
126.	"Golden Wax," Fer.	"	"	Short, flat	Medium, dark eye	"
127.	"Golden Wax," Fer.	"	"	Long, flat	" " "	"
128.	"Golden Wax," Fer.	"	"	Short, flat	" " "	"
129.	"Scimitar," Hen.	"	Purple	Long, round	Medium, black	"
130.	"Golden Eye," Thr.	"	White	Short, flat	Medium, yellow eye	"
131.	"Jones' Stringless," Vau.	"	"	Medium, round	Medium, white	"
132	"Keeney," J. & S.	Small	Purple	Long, round	Medium, dark mottled	Med. early.
133.	"Keeney," Hlm.	"	"	" "	" " "	" "
134.	"New Round Pod," J. & S.	Medium	White	" "	Medium, dark eye	" "
135.	"Market," Hen.	"	Pink	Long, flat	Medium, light brown	" "
136.	"Pencil Pod," Fer.	Small	Purple	Long, round	Medium, dark mottled	" "
137.	"New Profusion," Mau.	"	"	" "	" " "	" "
138.	"Lan. Scarlet," Lan.	Large	Pink	Long, flat	Medium, red	" "
139.	"Refugee G. P.," N. K.	Medium	Purple	Long, round	Medium, dark mottled	" "
140.	"Stringless," Ham.	"	White	Short, round	Medium, white	Early.
141.	"Saddleback," Hlm.	"	Purple	" "	Medium, black	"
142.	"Wardwell's Kidney," N. K.	Large	White	Long, flat	Large, dark eye	"
143.	"Wardwell's Kidney," Btl.	"	"	" "	" " "	"
144.	"Wardwell's Kidney," Bur.	"	"	" "	" " "	"
145.	"Crystal," Fer.	Small	"	Short, round	Small, white	Late.
146.	"Yosemite," Drr.	Large	Purple	Long, round	Large, black	Med. early
147.	"Allan's Imperial," Sal.	Small	"	Short, flat	Medium, dark mottled	" "
148.	"Pencil Pod," Liv.	"	"	Long, round	" " "	" "

Novelties in Bush Beans.

A few sorts of beans were grown this season that are not in previous lists of our experiments from No. 1 up to No. 149. The following notes are given, with the list number assigned to each:

No. 149. "Burpee's White Wax." The plants of sturdy growth, with large, broad leaves, are similar to "Wardwell's Kidney" (144), and have broad pods with white seeds.
" 150. "Butter Wax." This is of the "Golden Wax" type (Nos. 118-123).
" 151. "California Black Wax." Having medium length, flat, straight, yellow pods with black seeds. This number is close to the numbers 102-110. It was quite prolific.
" 152. "Eldorado Wax." This is quite similar to 151, but with longer pods.
" 153. "Golden Jersey Wax." This seems to be a selected strain from the "Golden Wax" (No. 118-123).
" 154. "Ventura Wonder." This seems to be an improvement upon the "Davis' Wax" (111-112), with long, yellow pods and a good bearer.
" 155. "Crimson Beauty." This is similar to "Goddard" (18), with the green pods beautifully marked with red. It yielded well.
" 156. "King of the Earlies." This has a desirable pod, long and curved, striped at maturity, and bearing black seeds.
" 157. "Prolific Market." This gave late, "viney," green-podded plants, inclined to run.
" 158. "Silver Refugee."
" 159. "Yankee Winter." This is a green-podded sort, forming small, spreading plants, about the size of "Crystal Wax," and as desirable.
" 160. "Asparagus." This resembles closely the forage plant known as "Cow Pea."

Experiments with "Jackson Wonder" Bush Lima.

The "Jackson Wonder" bush lima bean is remarkably prolific, and were it not for its striped seeds it would be perhaps the leading variety, except with those who insist upon having the large, thick-fleshed bean of the "Burpee" or "Dreer" types. This "Jackson" has a great tendency to vary in the amount of the dark color in the seed, some plants producing those with the seeds nearly white.

In 1904 a block of a hundred or more plants was grown from the darkest selected seeds and another with the lightest seeds to be found in a pound package of the commercial seed. From the crop secured from these plantings, made in widely separated parts of the Gardens, the darkest and lightest seeds were again selected and planted separately.

The result of this second crop does not indicate any great effect of the repeated selection upon the color of the seed. In other words, the light seeds from the light seeds are nearly as dark as those from the second generation of selected dark seeds, a somewhat unexpected result, suggesting that the prolificness of the "Jackson Wonder," combined with white seed, may be more quickly obtained by breeding than mere selection.

EXPERIMENTS WITH EGGPLANTS.

The following is a list of eggplants that were grown in the Gardens the past season, with the source of the fresh seed, number of plants and fruits secured. In case of No. 10 the fruits were allowed to mature, that the seed might be saved, and this doubtless reduced the number of marketable fruits that might otherwise have been produced had they been removed when ready for the table:

Record No.	Name and Source of Seed.	Number of Plants.	Fruits Gathered.
1	"Baltimore," G. & F.	16	24
2	"Black Snake," Thr.	27	198
3	"Black Pekin," Thr.	37	105
4	"Black Beauty," Thr.	20	53
5	"Dwarf Purple," Thr.	15	97
6	"Early Dwarf Oval," Steck.	16	108
7	"Excelsior Tree," Mau.	15	57
8	"Florida High Bush," Wood.	16	72
9	"Giant N. Y. Spineless," Chl.	4	13
10	"Jersey Belle," N. J. Sta.	190	580
11	"Long White," Thr.	8	36
12	"Long Purple," Thr.	11	43
13	"Mammoth Purple," Thr.	17	24
14	"Fordhook Improved"	Failed.	...
15	"Mammoth Pearl," Fer.	8	17
16	"New White Pearl," Evr.	5	17
17	"New Excelsior Tree," Hlm.	20	93
18	"New York Improved," Bar.	9	20
19	"New York Improved Purple," Vau.	12	28
20	"Pride of Sunnyside," Ford.	7	24
21	"Striped," Thr.	7	46
22	"Purple Perfection," Tait.	5	4
23	"Thornless Long Red Purple," Lan.	13	59
24	"New White," Mau.	6	21
25	"Scarlet Chinese," Thr.	25	Very numerous.

The following is a preliminary classification of the above list of eggplants:

Plants Tall:
- Leaves Purple—
  - Fruit slender, "Black Snake" (2).
  - Fruit round, "Black Pekin" (3).
- Leaves Green—
  - Fruit oval, "Excelsior Tree" (7).
    - "Florida High Bush" (8).
    - "New Excelsior Tree" (17).
    - "Thornless Purple" (23).
  - Fruit long—
    - White, "Long White" (11).
    - Purple, "Long Purple" (12).

Plants Medium Tall:
- Fruit Purple—
  - Large, "Mammoth Purple" (13).
  - Medium, "Giant N. Y. Spineless" (9).
    - "Jersey Belle" (10).
    - "New York Improved" (18).
    - "New York Improved Purple" (19).
    - "Pride of Sunnyside" (20).
    - "Purple Perfection" (22).
- Fruits White—
  - Large, "Mammoth Pearl" (15)
    - "New White Pearl" (16).
    - "New White" (24).
  - Small, "Striped" (21).

Plants Medium Short:
- "Baltimore" (1).
- "Black Beauty" (4).

Plants Dwarf:
- "Dwarf Purple" (5).
- "Early Dwarf Oval" (6).

Notes upon above Eggplants.

An opportunity offered for the study of the above commercial sorts of eggplants as grown in the same block of the Gardens, and the following notes are drawn from the record book for the year:

1. *"Baltimore."* The plants are of a medium dwarf type with light green foliage and giving medium large, oval purple fruits in small numbers. The fruits soon decay without turning orange, as in the plants with purple foliage like "Black Snake," and the true dwarfs (Nos. 5 and 6). The sort nearest to it is the "Black Beauty" (4), from which it may perhaps be distinguished by a lighter purple to the surface of the fruit.

2. "*Black Snake*." The plants are unusually slender and tall, with the leaves narrow and purple. It is early, but the fruits are so long and slender as to be of little value for the table. The plants continue to bloom and bear fruit until frost kills them. The fruits turn yellow at maturity. It is a spineless variety and on this account is of much value in breeding. From it, in combination with the "New York Improved," has been secured a long, large-fruited cross that is of much market value and has thus far shown no spines.

3. "*Black Pekin*." This is a distinct variety, as shown by its purple stems and foliage, tall habit of growth and large, nearly spherical fruits, showing the absence of the dark purple color beneath the large calyx lobes. This last peculiarity is shared by the "Black Snake," "Dwarf Purple" and "Early Dwarf Oval." The plants are not very prolific and the fruits are quite inclined to crack before they are large enough for the table. The leaves are much less injured by the potato beetle than those of the green sorts.

4. "*Black Beauty*." This is so close to the "Baltimore" that the same remarks apply to both.

5. "*Dwarf Purple*." The dwarf habit (one to one and a half feet high) is so marked that this is a well-defined variety. In the purple color of the stems, foliage and fruit it resembles the "Pekin," but its foliage is long and narrow, more like the "Black Snake," and the fruits are almost pear-shaped and quite small as compared with those of standard sorts and much less rapid in decay. The calyx is purple and the flesh of the fruit beneath its lobes is green. The chief merit of the small plants is in their earliness, producing fruits before any other sort, and continue to bear until late in the season. Old plants sometimes show several straw-yellow, pear-shaped, mature fruits, which, upon cutting with a knife, exhibit much firmness, especially near the surface, while the seed cavities are much better defined than in such fruits as those of the "Pekin" or "New York Improved" type. In other words these dwarfs show a characteristic solidity in the fruit that is quite resistant to the ordinary form of decay in eggplants. It is not spineless.

6. "*Early Dwarf Oval*." This was grown alongside of No. 5 and no difference could be detected between the two.

7. "*Excelsior Tree*." This is a tall, broad, green-leaved, late, somewhat spiny sort, with medium-sized, oval, purple fruits.

8. "*Florida High Bush*." This was grown next to No. 7, and not easily distinguished from it.

9. "*Giant N. Y. Spineless*." This was represented by only four plants, due to a poor stand in the seed box. The plants were only medium tall, with green stem and leaves and medium-sized, oval, purple fruits. It was not spineless, but fairly early in bearing.

10. "*Jersey Belle*." A large block of plants of this Station sort of eggplant was grown the present season. The record-book states that the 190 plants were noted for their vigor and early blooms. Two types of plants were distinguishable in the latter part of the season, the one being tall with purplish stems and leaves and inclining in these respects to the "Long Purple" parent, and the other medium tall with less purple in the stems and foliage and thus favoring the other parent, the "New York Improved." The first fruits were picked for the table July 10th, and the first picking of fifty mature specimens for seeding was made early in August. All the plants bear the same long, bell-shaped fruits of a rich purple color. All the plants are somewhat spiny.

11. "*Long White*." This is a tall, broad, green-leaved sort, the fruits of which are medium long, early and fairly productive of greenish-white fruits that are as palatable as the purple sorts, but less attractive in the market.

12. "*Long Purple.*" This variety differs very little from the last, excepting in the purple color of stem and fruit and a darker green foliage. It is fairly early.

13. "*Livingston's Mammoth Purple.*" This is in the group of the "medium tall plants," with green foliage and large, oval, purple fruits. It was not productive, as the record in the preceding table shows.

14. "*Fordhook Improved.*" The seed of this sort failed.

15. "*Mammoth Pearl.*" Of the "medium tall" group, with light green foliage and large, oval, white fruits that were late in maturing. The leaves are more deeply lobed than in other sorts. There were but few specimens.

16. "*New White Pearl.*" This resembles No. 15, with somewhat larger plants and fruits. The latter showed a tendency to turn yellow upon maturing, in this approaching the "Black Snake" and the "Dwarfs."

17. "*New Excelsior Tree.*" This is, as its name suggests, one of the tall group, with long, spreading branches, bearing light green foliage and oval fruits of medium size, and of a light purple color. It is a late and somewhat spiny sort. It is near to No. 7.

18. "*New York Improved.*" A member of the "medium tall" group, with light green foliage and good-sized, oval, purple fruits. It is medium early and spiny.

19. "*New York Improved Purple.*" This seems to be the same as No. 18.

20. "*Pride of Sunnyside.*" This is not easily distinguished from the last two, alongside of which it was grown.

21. "*Striped.*" This is a variety characterized by its very white fruits, with the flesh nearly of the whiteness of the snow-apple. The plants are medium tall, with close, upright habit of growth, foliage light green and the fruits long, not large, and without more than the slightest indication of stripes. It is quite spiny.

22. "*Purple Perfection.*" This did not differ materially from the "New York Improved" group. There were but few plants and those made an indifferent record.

23. "*Thornless Purple.*" This is a tall sort, much like No. 7, but the fruits differ in the red-purple color. It was slow growing and among the late kinds, with spines plentiful.

24. "*New White.*" This agreed in all points with No. 15, with fewer spines and the fruits perhaps more slender.

25. "*Scarlet Chinese.*" This is added here because it is being bred with the ordinary eggplants. It is a very distinct species and treated elsewhere under the head of its hybrids. The plants are tall, woody and very spiny. The fruits are produced in great numbers and are of such a durable nature that a string of them hung in the greenhouse throughout the past winter reminded one of red peppers, although the shape is flat and more like some tomatoes.

Cross of "Long White" upon "New York Improved."

A block of thirty plants, representing the third generation of the cross of the "Long White" upon "New York Improved" ($\frac{11}{18}$), gave a great variety of plants. They were all of medium size, with the foliage light green and the leaves broad. Generally they fruited early, but some individuals were quite late in coming into bearing.

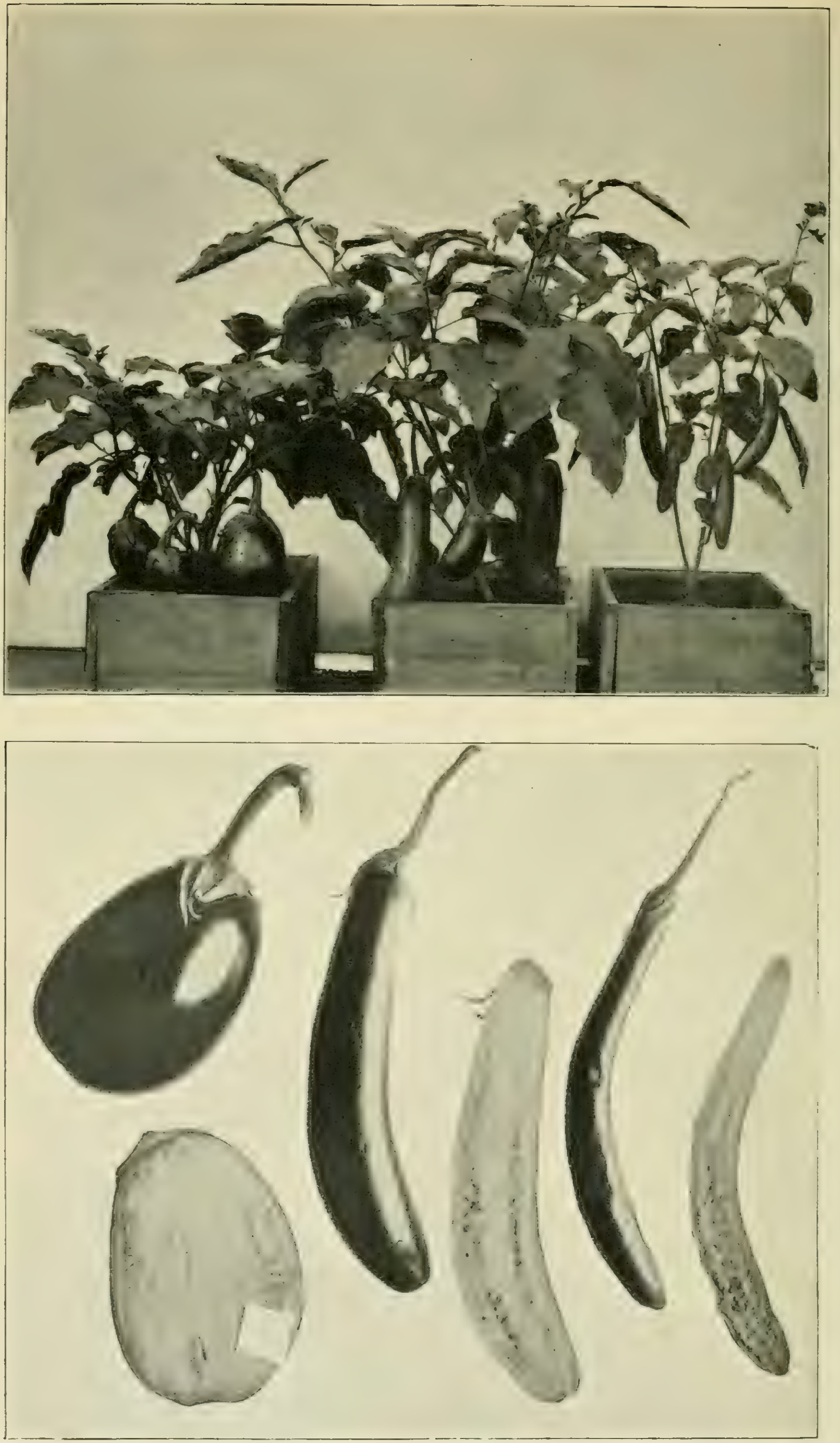

PLATE IX.

Crossed Eggplants. The male parent plant, "New York Improved," is shown in the box upon the left, and the mother, "Black Snake," upon the right, while the cross is placed between them. The same arrangement of the three sets of fruits is shown in the lower portion of the plate.

As a rule, the fruits were well shaped—that is, oval or medium long—and varied from white to dark purple. In color several were quite objectionable. This variability is not unexpected, when one parent is white and the other purple in color of fruit. There were some very thrifty plants, with almost grass-green fruits, while others had the green and purple so combined as to produce a blotched and streaked appearance not preferred in the market.

Seeds were saved from only two of the plants and these were exceptionally fine in many respects, and agreed in having the many fruits—one seven and the other nine—of a delicate pink color when ready for the market. In shape they were somewhat thicker and shorter than those of the "Long Purple" variety, and altogether very acceptable. The usually firm flesh is of a fine white, resembling that of a snow-apple, and found nowhere else, in our experience, outside of the "Striped" variety listed as No. 21. In other words, the two plants selected show some distinctive characters that it is hoped may become fixed.

Cross of "New York Improved" upon "Black Snake."

A block of sixty plants of the cross of the "New York Improved" upon "Black Snake" ($\frac{18}{2}$) gave a very even lot of eggplants. The plants were usually very tall, with purple stems and leaves, in this respect resembling the mother parent, and bore a large crop of fruits through a long season. For the sake of a picture, a plant of each parent and one of the cross were placed in boxes in midseason, and after a few days, and the wilting had been overcome, they were photographed, as shown in the upper half of Plate IX. The male parent, "New York Improved," is upon the left; the mother, "Black Snake," upon the right, and the cross stands between. As these were average plants and all of the same age, something of the resemblances and differences may be distinguished. The fruits were quite uniformly long, with the sides nearly parallel, suggesting unusually large-sized window weights, average ones measuring ten inches long by three and a half inches in diameter. The tall, stiff stems of the plants enabled these long fruits to be held, as a rule, free from the ground, and when touching it was only by the end, thus helping to keep them from the decay that attacks large eggplants lying upon the earth through nearly their whole growth. Many of the fruits are curved somewhat, a characteristic that comes naturally from the "Black Snake" parent.

Crossed eggplants have, with us, always shown a remarkable vigor, and this instance is a striking application of the rule. The block showed so many good qualities in strength of plant and fruitfulness, and with all so uniform in fruit characteristics, that a considerable quantity of seed was saved from the best plants, which will be distributed under the record number 18 x 2 (Station Eggplant No. 1), that its merits may be tested by those who grow this kind of vegetable for profit as well as home use.

Something of the nature of the fruit of this cross is shown in the lower part of Plate IX. There a young fruit is shown, surface view and in section, in the middle of the picture, and the male parent upon the left and the mother upon its right-hand. It escapes the objectionable feature of both parents by being enough larger than the "Black Snake" and smaller than the "New York Improved" to make good-sized slices and many of them. It is to be remembered that the "Black Snake" is an early and profuse bearer, holding on in our climate until the frosts cut down the plants, but the fruits are too slender to be acceptable in the market. The cross in question brings up the size of the fruit and makes them of a convenient shape for cooking without any apparent loss of vigor and fruitfulness of the plant. The mother variety has the calyx strongly purple, with the flesh of the fruit beneath its lobes colored green. The fruits, in maturing, turn of a straw-yellow shade. These qualities the cross has in some instances and not in others, a point perhaps without practical value, but of interest in the breeding of this vegetable.

The breeding together of the two varieties in question seems to show that the "Black Snake" dominates over the "New York Improved." This is shown in an emphatic manner in the matter of spines. The male parent is a spiny sort, while these objectionable points are absent from the "Black Snake." No spines have been found upon the cross, and the writer has frequently drawn its foliage through the hands and rubbed the calyx and fruit stalk without feeling the least discomfort. It seems quite evident that the cross, when fixed, will be a commercial sort that is truly spineless, a fact not met with in any of the large-fruited varieties that have been grown in the Gardens.

The cross in question is not a mammoth "Black Snake," as might be inferred from the above, for the "New York Improved" has imparted a good share of its qualities, easily seen, for example, in the

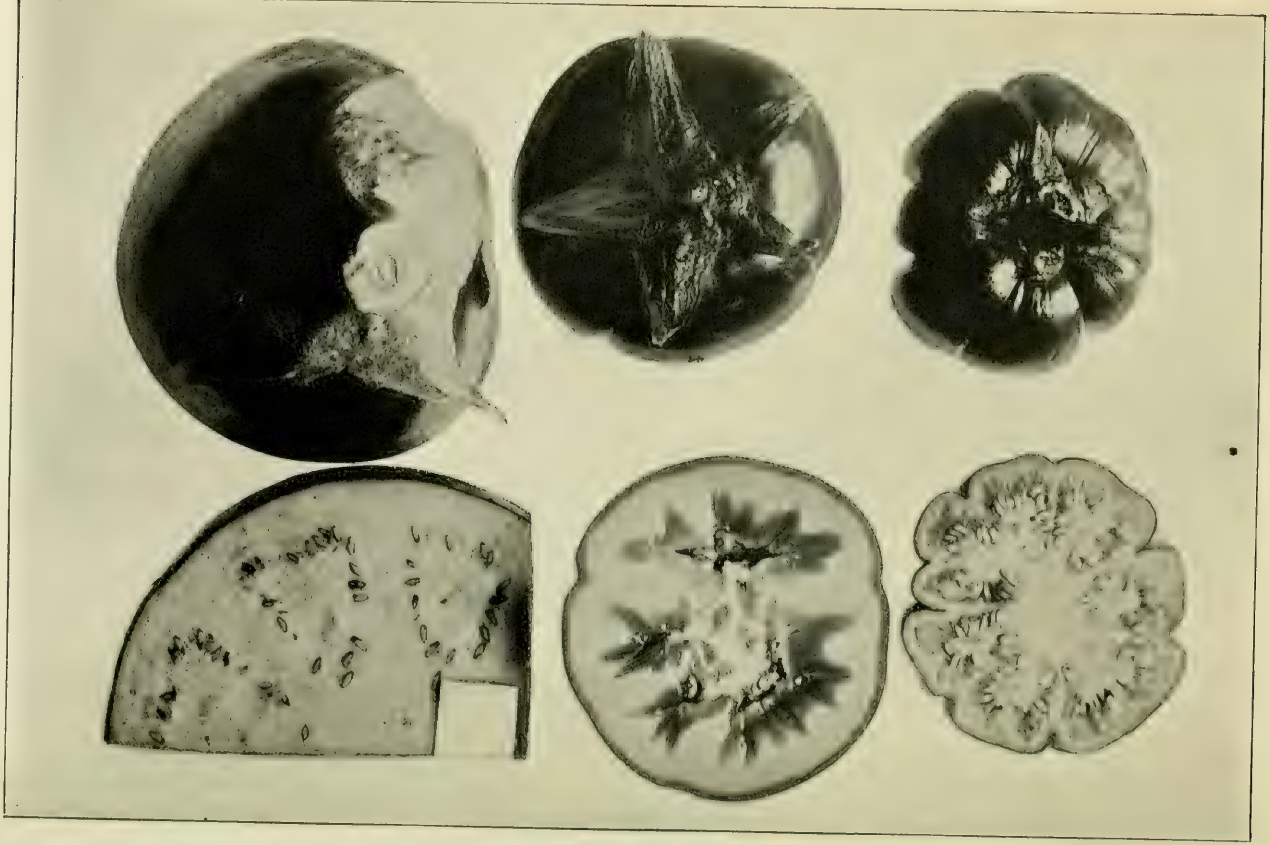

PLATE X.

Hybrid Eggplants. Fruit of the male parent (ordinary Eggplant) is shown upon the left, and the mother ("Scarlet Chinese") upon the right with the hybrid between them. The card is a half inch square.

foliage. It is possible that it may bear the name abroad that it is known by in the Gardens, namely, the "Longfellow," but the seed will go out under the cross record 18 x 2, or Station Eggplant No. 1.

A Hybrid Eggplant.

During 1904 a fruit was obtained upon a "Scarlet Chinese" eggplant (*Solanum integrifolium* Poir.) after treatment with pollen from one of the common garden varieties of eggplant, the "Fordhook Improved" (*Solanum Melongena* L.) ($\frac{14}{25}$). As a result, one seed grew and produced a plant that has shown itself to be an unmistakable hybrid between these species. The *Solanum integrifolium* is a tall-growing bush, with comparatively smooth, deeply-lobed leaves, armed upon both sides of the vines with stout, sharp spines and small flowers, in clusters, that produce numerous small, flat fruits, with prominent lobes and of a bright, scarlet color. The fruits are so durable that they may be strung, like peppers, and kept for many months. It is on account of these bright, shiny fruits that this species, probably from Africa, has long been grown for ornament. The contrast with the ordinary edible eggplant species is quite marked.

The hybrid plant in question was unusually thrifty from the start, and during the last half of the season exhibited a broad top, several feet across, and continually loaded with a hundred or more of blooms, midway in size between the two species involved in the union. The plant in other ways differs from the parents, as, for example, the handsome, purplish leaves are near to the "Chinese" in outline, combined with the soft texture of the "Fordhook," and abounding in spines, those upon the stems resembling the prickles of rose canes.

While the plant produced a great display of flowers, the setting of fruit was the exception, and it was the 1st of October before a single mature fruit was secured. This was with three shallow grooves, somewhat flat, a bright orange and about two and a half inches in its greater diameter. This specimen was cut in halves and photographed, both in surface and interior view, along with corresponding views of fruits of both parents, as shown in Plate X.[1] It is to be observed that the fruit is larger than the "Chinese," shown upon the right, and there is only a slight suggestion of its deep grooves. The calyx is in size and texture nearly midway between the two species. Within the differences are greater, for here the firm flesh is seen to be quite thick, resembling neither parent in texture. That there were only thirty-nine seeds may have something to do with the appearance of the slice, and other fruits may show a modification here. While it indicates that it may have good keeping qualities, there is little in the substance of the fruit to suggest much economic value.

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[1] As all the "Fordhook" seed failed this season, the male is represented in the picture by a fruit of "New York Improved," which has all the essential characters, for this purpose, of the "Fordhook."

The plant grew without stint until the hard frosts of November put an end to the life of the hybrid plant. In midsummer, seeing that it would fruit but very sparingly if left to itself, many blossoms were served with pollen from the esculent sorts, as well as from the "Chinese" species, and at the close of the season there were many fruits of full size and some ripe enough for seed.

In a few words, this hybrid shows remarkable vigor, growing to perhaps three times the size of its parents, with a great tendency to produce blooms, which quickly fall away. It behaved like a perennial and did not find time in an unusually long season to mature more than two dozen fruits. The chief hope with this hybrid, from an economic standpoint, is to breed it to the *Solanum Melongena*, with the thought of making it productive of good-sized fruits, having a fine, firm flesh, that will bear transportation well and resist decay much longer than our present type of eggplants.

EXPERIMENTS WITH SUMMER SQUASHES.

The work with summer squashes was continued during the year, and the subjects in hand are shown in their combinations in the following table. Each variety has a numeral assigned to it, and the method of union is known by the position of the numbers. The key to the varieties is as follows:

No. 5. "Yellow Crookneck." The common type of warty squash.
" 6. "Long Island Scallop." A cream-colored, smooth squash.
" 8. "Early Bush." A cream-white, smooth scallop."
" 9. "Golden Bush." A solid yellow, smooth "scallop."
" 10. "Mammoth White Scallop." A cream-white fruit.
" 11. "Strickler's Summer." An orange-colored, warty "crookneck."
" 12. "Silver Custard." A deep, somewhat ribbed, cream-white "scallop."
" 13. "Giant Summer." A long, "straightneck," with few warts.

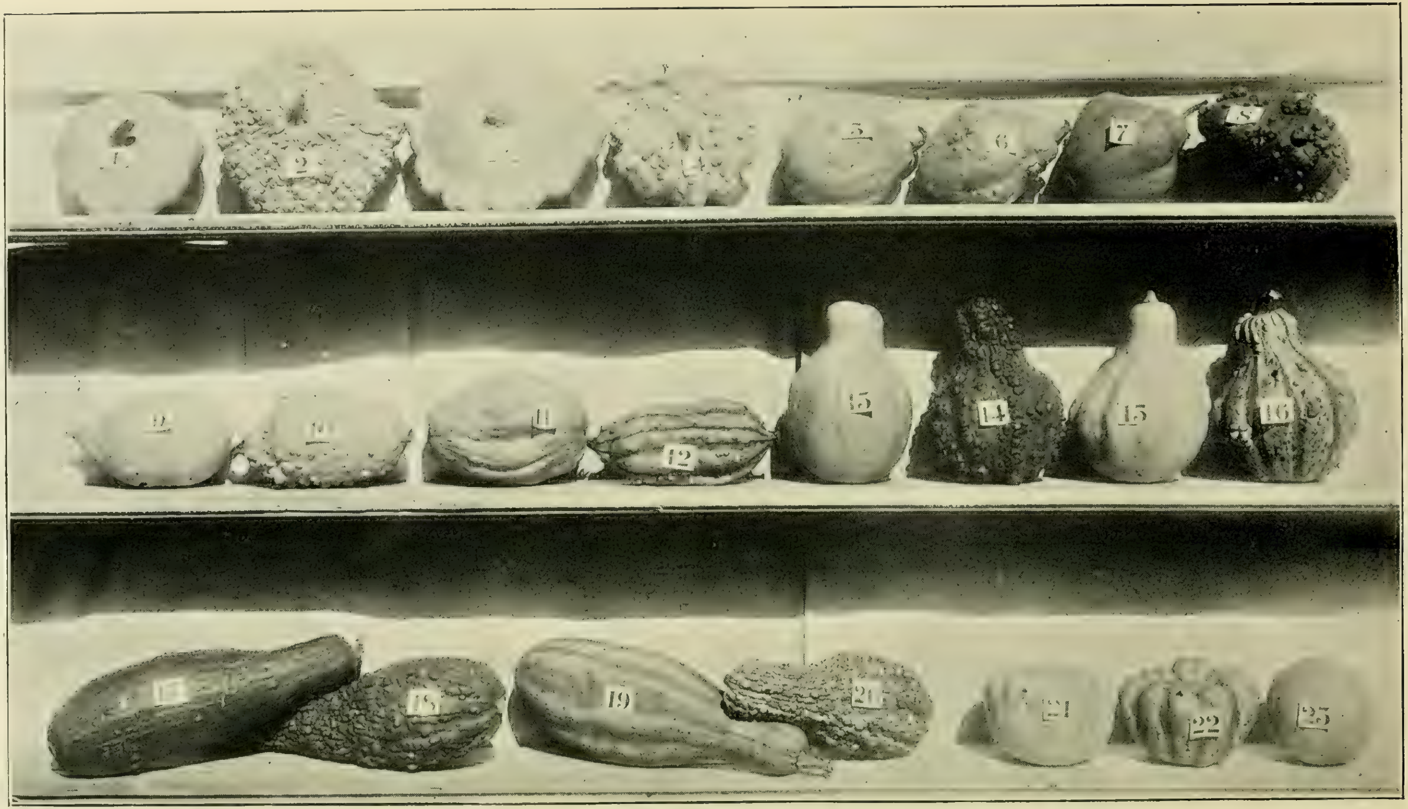

PLATE XI.

Types of Summer Squashes from among the crosses. The numbers upon the fruits correspond to those in the table of types. From 1 to 4 are flat; 5 to 8 rectangular; 9 to 12 oval; 13 to 16 "Jug"; 17 to 20 long-neck; 21 to 22 "Cheese," and 23 spherical.

In the scheme that follows, the crosses are arranged to the first figure in the combination—that is, all with 5 precede those with a higher initial number. Thus, IX. 5 (6 x 5) 5 (6 x 5) indicates that the combinations are as follows: Six was crossed upon 5—that is, "Scallop" upon "Crookneck"—and the next year after 5 was crossed upon this cross (6 x 5), giving a three-quarter blood of the "Crookneck" to one-quarter of the "Scallop," and the present year a cross of the two crosses has been grown as No. IX. of the series of crosses. In other words, a cross of "Crookneck" ("Scallop" upon "Crookneck") was bred to its own cross last year, and plants of this combination were grown this season.

Thirty-three crosses of summer squashes secured in 1903 or 1904 were grown the present season. The Roman numerals stand for the rows which extended across the plot. Each row, of nine hills, was planted with seed from the same fruit, and the nature of the cross is indicated in the second column, and a key to the record figures is given below. Some of the facts obtained as to vines and fruits are condensed into the following tabular form. The record was made early in the season, and therefore upon the first fruits. Later on the number of fruits increased many times, but the fruits of any particular vine do not vary materially:

Row number.	The cross.	Number of vines.	COLOR OF VINES.		COLOR OF FRUIT.				SHAPE OF FRUIT.			Wartiness.
			Light green.	Dark green.	Cream.	Yellow.	Striped.	Other.	Flat.	"Jug."	Longneck.	
I.	5x5	17	.....	......	8	5	Much.	.....	2	21	.....	Little.
II.	5x9	18	.....	......	3	13	Little.	......	13	3	......	Very little.
III.	5x10	22	......	......	22	......	None.	.....	22	......	......	Little.
IV.	5x12	16	......	......	5	11	Little.	......	5	11	......	None.
V.	5 (5x6)	21	5	16	......	20	Much.	......	15	5	.....	Little.
VI.	5 (6x5)	27	8	19	14	14	Little.	......	13	15	.....	None.
VII.	(5x6) (6x5)	30	12	18	7	20	Little.	3	14	16	1	Little.
VIII.	(5x6) 5 (6x5)	27	11	16	12	9	Much.	6	7	20	....	Little.
IX.	5 (6x5) 5 (6x5)	24	13	11	16	3	Little.	5	8	15	.....	Little.
X.	(5x6) 11	16	4	12	5	11	Much.	.....	4	10	2	Much.
XI.	6x5	20	16	4	21	......	None.	.....	9	12	......	Little.
XII.	6x9	31	19	12	30	....	None.	.....	30	......	.....	Very little.
XIII.	6 (5x6)	.....	6	11	7	8	None.	2	7	9	1	Very little.
XIV.	6 (6x5)	27	20	7	28	1	None.	......	15	14	......	None.
XV.	(6x5) (5x6)	27	22	5	28	......	Much.	2	21	7	......	Little.
XVI.	(6x5) (6x5)	26	14	12	16	6	Little.	1	11	12	......	Very little.
XVII.	(6x5) 11	15	7	8	17	16	Little.	......	......	26	7	Much.
XVIII.	8x5	11	11	......	10	......	None.	......	10	......	......	Little.
XIX.	8 (5x6)	16	12	4	17	......	None.	......	14	3	......	Little.
XX.	8x12	13	10	3	14	....	None.	....	14	.....	......	Little.
XXI.	9 (6x5)	21	5	16	4	17	Much.	......	17	4	.....	Little.
XXII.	10x11	29	29	......	26	3	None.	......	14	15	.....	Little.
XXIII.	Failed.	.....	.....	......	......	.....	....	......	.....	.....	.....	....
XXIV.	10 (6x5)	17	17	.....	16	....	None.	......	13	3	......	Little.
XXV.	11x5	23	......	23	......	23	None.	......	......	......	23	Much.
XXVI.	11x9	22	.....	22	......	22	None.	......	... ..	22	......	Little.
XXVII.	11x10	24	24	.... .	24	......	None.	....	......	24	......	Much.
XXVIII.	11 (5x6)	23	7	16	5	20	Much.	....	4	17	4	Much.
XXIX.	11 (6x5)	24	9	15	7	17	None.	.....	2	9	13	Much.
XXX.	12x9	20	17	3	20	......	None.	.....	20	......	......	Little.
XXXI.	12x11	25	10	15	10	14	None.	.....	3	21	......	Much.
XXXII.	12 (5x6)	24	16	8	17	3	Little.	4	15	9	......	Much.
XXXIII	12 (6x5)	23	19	4	31	......	None.	.....	15	16	.....	Little.
XXXIV.	13x11	24	.....	24	......	24	None.	....	......	......	24	Much

The color of the vines was overlooked for the first four numbers. It is observed that the color of the vine is associated with that of the fruits—that is, for example, the light green of the plant is connected with the cream-colored fruit, and, contrarywise, the dark green with the yellow, with exceptions in many cases. Some rows are all light green and have only cream-colored fruits; others all dark green and yellow-fruited. The rows carrying the cream-colored fruits show very little stripes, while those with much yellow are more inclined to have the stripes and to be long, or not flat. Thus the last row (XXXIV.) had all its twenty-four vines dark green, yellow-fruited, long neck and warty, and row XXVI. had its twenty-four vines all light green, cream-fruited, jug-shaped and warty. These results were as anticipated, for the parents are much alike in each pair. It is among the crosses of the "Scallop" and "Longneck" that the association of leaf and fruit color is most interesting.

Mr. Owen, during the season, made a vast number of pollinations among these crosses. At first suitable paper bags were employed in covering the male and the female flowers upon the afternoon of the day previous to their opening. This method had its disadvantages, and for a time strings (wire labels) were used instead. This method consisted in simply twisting the wire closely around the unopened corolla toward nightfall to prevent the entrance of insects during the few hours in the early morning, before the flowers could be hand-pollinated. It was found that small insects would sometimes force themselves through the folds of the corolla, and for perfect safety the bags, while less convenient, were again resorted to. The pollination was made under the following rules: (1) Always pollinate within the cross and either (2) between two plants with the same type of fruit or (3) within the same plant. By planting the mature seeds from a score of fruits secured by hand-working within the plant, it was found that such seeds were viable. After this the pollination was usually made between the two kinds of flowers upon the same plant. In this manner a large stock of seed has been secured, by means of which it is hoped to finally obtain plants that will reproduce their kind as perfectly as the ordinary commercial types of squashes. The stability of form of the latter is largely a matter of keeping the seed pure, and this is difficult and almost beyond the hope of the ordinary grower unless the plantings are isolated and limited to one sort or the flowers are purposely hand-worked for the necessary seed for the next season's use.

Second Crop of Summer Squashes.

Many fruits were obtained among the crossed squashes by phytofertilization—that is, within the same plant—and seeds from these were planted in July and early August as a test of the vigor of plants thus produced, and to determine something of the range of variation in such sets of plants of identical parentage. A few of the resulting fruits grew to marketable size, but the majority were small, and the shape at maturity is somewhat a matter of inference.

There were eight rows, of four hills each, that gave the following results:

Row.	Color and Shape.	Number of Sizable Fruits.	Remarks.
1	Cream, scallop	2	Very nearly true to parent.
2	Cream, "jug"	3	" " " " "
3	Striped, dark and light green	2	" " " " "
4	White, scallop	1	" " " " "
5	Cream, "jug"	3	" " " " "
6	Pink, warty "jug"	5	Quite variable.
7	Deep scallop	4	Very nearly true to parent.
8	Yellow, rectangular	3	" " " " "

There seems to be hope of fixing the desired types through fertilization within the plant.

Types of Summer Squashes.

During the present season the two plots filled with crosses of summer squashes gave an opportunity to formulate a preliminary classification of this group of vegetables. It is founded entirely upon the shape and surface characters of the fruits, and therefore each type may be further subdivided upon the basis of color or other qualities.

The classification assumes that the flat, smooth, unscalloped fruit is the simplest general type of squash, and the long, warty and fluted one the most complex.

Type.
1. Flat, smooth, not scalloped.
2. " " scalloped.
3. " warty, not scalloped.
4. " " scalloped.
5. Rectangular, smooth not scalloped.
6. " " scalloped.
7. " warty, not scalloped.
8. " " scalloped.
9. Oval, smooth, not fluted.
10. " " fluted.
11. " warty, not fluted.
12. " " fluted.

Type.
13. "Jug," smooth, not fluted.
14. " " fluted.
15. " warty, not fluted.
16. " " fluted.
17. Longneck, smooth, not fluted.
18. " " fluted.
19. " warty, not fluted.
20. " " fluted.
21. "Cheese," smooth, not fluted.
22. " " fluted.
23. Spherical, smooth, not fluted.

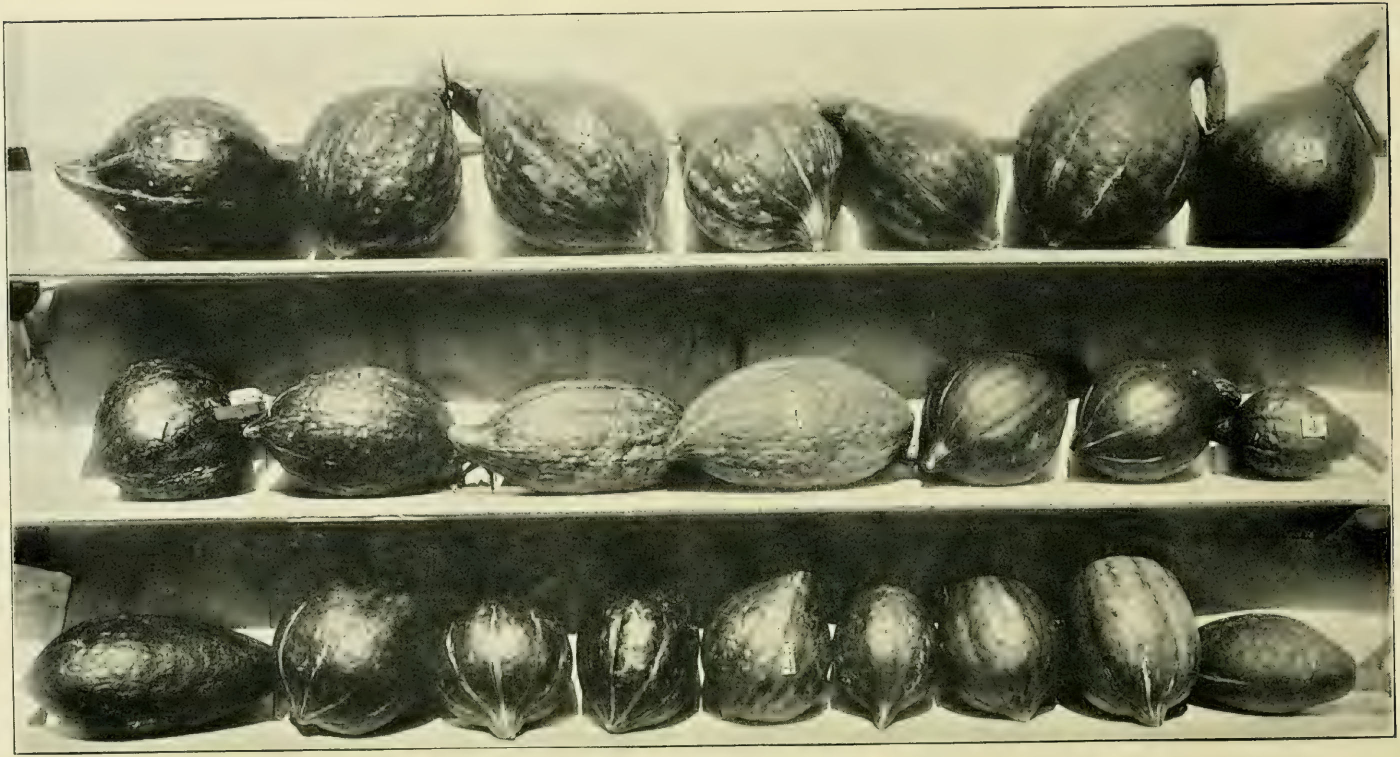

PLATE XII.

Crosses of Winter Squashes. The top row shows the parents "Hubbard" (1) and "Boston Marrow" (2) at the ends, and their crosses (½) between them. In the same manner "3" and "4" are given in the second row, while the double crosses ½ upon ¾ are shown below.

These types are given in the above order, with corresponding numerals, in Plate XI. The "Cheese" forms (Nos. 21 and 22) naturally come in between "rectangular" and "oval" types, and the "spherical" (No. 23) is just before the "ovals," also, but, not having specimens to show the lacking forms in the theoretical scheme for these general types, the ones at hand were added at the end.

EXPERIMENTS WITH WINTER SQUASHES.

In 1903 crosses were secured between the "Hubbard" upon "Boston Marrow" and "Delicious" upon "Golden Hubbard," but during last year only one fruit was obtained from these crosses, namely, of the "Delicious-Golden Hubbard," and this had been pollinated with the other cross above named—that is, the seeds carried the "blood" of four varieties.

It is with much difficulty that winter squashes, particularly of the "Hubbard" group, can be grown, on account of the swarms of beetles that attack the seedlings and the grub that afterward works in the base of the stem of any that survive the striped "bug." Beside these insect enemies there is a wilt disease, more or less in evidence, so that it is necessary to plant very liberally to insure a small stand of plants. During the present year it was only through a second planting and daily attention that fruits were secured of the above crosses.

About twenty fruits were obtained of the "Hubbard" upon the "Boston Marrow" cross, and samples of these are shown in the upper row of Plate XII. The squash to the left, marked "1," is a fair specimen of the "Hubbard" or male parent, and the mother ("Boston Marrow"), marked "2," is shown in a small fruit at the right end, while the crosses, one of them marked "½," lie between. As a rule, the shape more nearly resembles the male, while in color there are strong indications of the cross. Nearly all of the fruits were of a pale or "pea" green, with the cream color showing in more or less well-defined streaks. In some instances the fruits were more cream orange than green, and none of them was of the solid olive green characteristic of the "Hubbard." Two large fruits of nearly the same general shape, but one green and the other yellow, were grown upon the same plant. It was generally true that the fruits of the same vine were not duplicates in appearances. At the time of writing it is too soon after the harvest to give full details of the internal characteristics or pronounce upon the keeping qualities of the crosses. All the fruits that thus far have been tested were of superior quality for table use. The somewhat striped pea green and cream orange surface of the cross is particularly attractive, and, judging from the yield under the very trying circumstances of the past season, it is to be expected that this "Hubbard-Marrow" will prove of value. Considerable seed has been saved for testing among the truck-growers of the State.

The cross between the "Delicious" and "Golden Hubbard" is shown in a row of five fruits upon the middle shelf in Plate XII. The male parent is shown at the left, marked "3," and the mother to the right, marked "4." This last is quite under size. The "Delicious" is a solid olive or "bronze" green, somewhat like the "Hubbard," but without any neck at the stem end, and therefore more nearly round and usually somewhat smaller than the last named. The "Golden Hubbard" is fairly well described in the name, and is a variety bearing a medium-sized and long cream orange fruit. It is seen that the crosses produced fruits that resembled the mother in length, some of them being quite long, and varied in color from a solid olive green, like the "Delicious," to a cream orange, like the "Golden Hubbard," while some were a striped mixture of the two. Here, again, it is too soon to describe the table and other qualities of these crosses.

The lower row of fruits in Plate XII. are all from plants that resulted from a combination of four of the above-mentioned varieties, and they show quite a range of variation. It is impossible to conclude, with so few specimens, what may come of this double cross.

All of the three sets were pollinated within the cross, so that the same crosses may be continued for further study.

The crosses among winter squashes gave vines in vigor, barring the severe experience they had with the beetles and extreme drought in the early part of the season. After the rains came, in August, the surviving squash vines took on renewed life and made many fruits, only a small proportion of which came to maturity.

The "Hubbard-Boston Marrow," of which there were twelve hills, suffered much more than the summer squashes from the beetles. Any plant that chanced to be unprotected by the fine mosquito netting had upwards of a hundred of the pests upon it and was quickly destroyed. In addition to the insects and bad weather, these vines

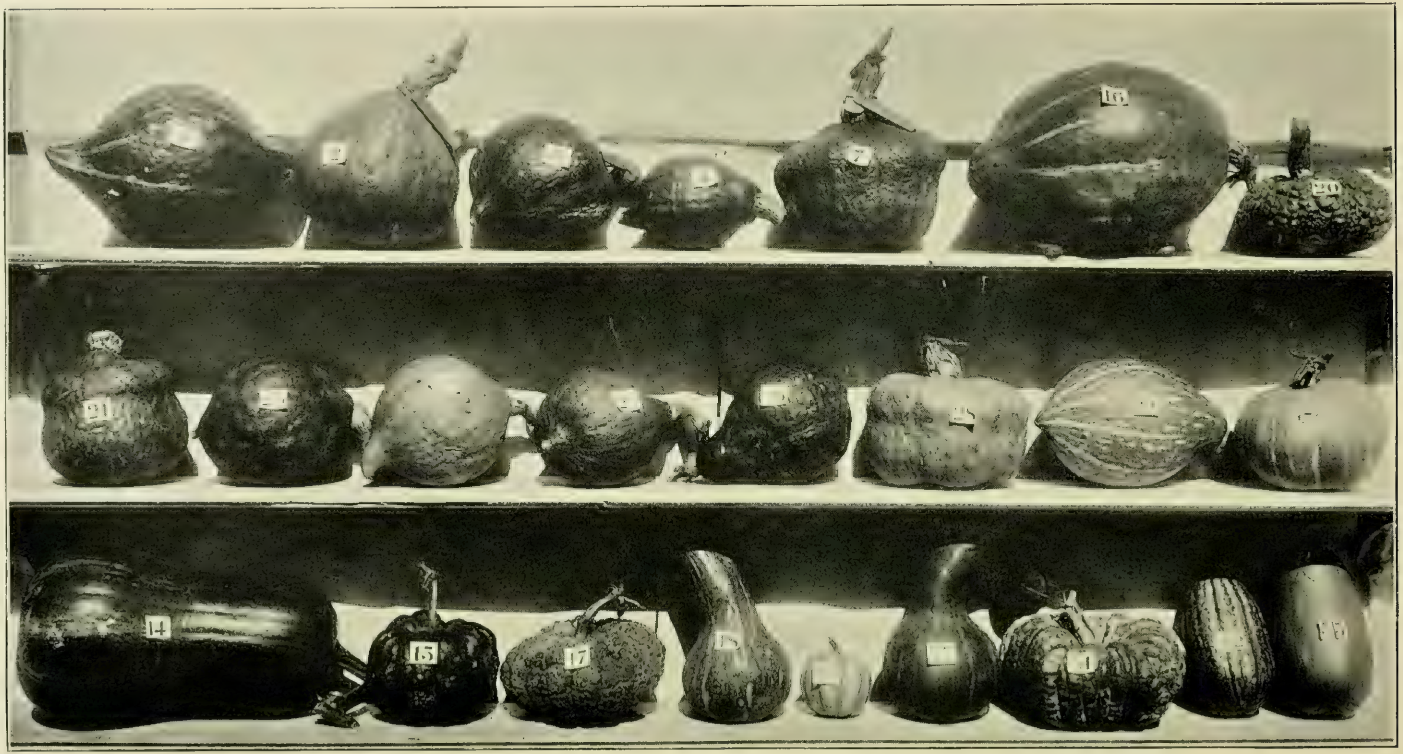

PLATE XIII.

A Set of Winter Squashes. The two upper rows show the fleshy-stemmed sorts, and those with hard stems are below. The record numbers upon the fruits correspond with those in the notes.

were badly attacked by the grub at the base of the stem and many were destroyed by it. The sole survivor of four hills, separated far from all the others, became a remarkably strong plant and yielded six large fruits. They show the mixture of the two parents in form and coloration of the fruits. They were quite uniformly of the shape shown at "½," in Plate XII., while the surface showed large blotches of a pale orange upon a background of pale, almost pea, green. Some of the orange blotches almost reach the length of the fruit and give the impression of long, irregular stripes. Both parents have affected the cross, and in no part of the surface is the original green of the "Hubbard" or orange of the "Boston Marrow" to be found.

Notes upon Varieties of Winter Squashes.

Quite a full list of the winter squashes was grown during the past season, and the following notes are here given in connection with the record numbers that have been assigned to each variety. The first four have been previously grown and considered in the reports. The numbers upon the fruits in Plate XIII. corresponded with those given below:

No. 1. "Hubbard." This is an old variety, with a history that, according to Mr. Gregory * reaches back more than a hundred years, taking its name from one Hubbard, who brought it to the notice of the seed trade nearly fifty years ago. The fruit is medium large and keeps quite closely to a definite shape, namely, larger near the blossom end, to which it tapers rapidly to quite distinct and curved point. Toward the stem the tapering is nearly as rapid for a distance and then extends in a broad neck until the stout, fleshy stem is reached. The fruit is usually somewhat one-sided—that is, the curves are less upon the under side, which is also otherwise somewhat flattened. The surface is slightly rough, due to broad ridges that are somewhat uneven, which, together with the longitudinal creases, gives rise to a coarse, warty appearance in extreme cases. The whole surface is quite evenly of a dark green, varying toward olive yellow upon the under side and to bronze when fully mature. The flesh is thick, somewhat olive green near the outline and more orange toward the center. A large number of large, white, oval seeds are usually produced.

No. 2. "Boston Marrow" was introduced in 1831. This has a large fruit with a short blossom end and very obscured neck, so that the general outline is nearly broadly ovate, with the longer taper toward the stem end. The surface is nearly smooth, the ribs being very indistinct, and in color the orange is interrupted only slightly by flint strips of a lighter color, which follow the depressions from the blossom end back for a third or more of the fruit. The blossom tip sometimes remains green. The flesh, not thick, is orange throughout, of the same color as the

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* "Squashes; How to Grow Them."

outside, and the seeds are large and white. The quality is not equal to that of the "Hubbard," but the variety is productive.

No. 3. "Delicious." The "Delicious," as before noted, has a smaller fruit than the "Hubbard," but resembles that standard sort in the solid olive or bronze green color. It has no neck at the stem end and in longitudinal view is long, egg-shaped, tapering nearly straight to the blossom end. The flesh is thick and of an olive orange color. During the present season this variety did better than any other, upon land that was too poor and dry for the "Hubbard" and "Boston Marrow." It is, in quality, high, and this, with the hardiness and productiveness, make this variety very desirable.

No. 4. "Golden Hubbard." This is a small-fruited, orange "Hubbard," with the squash long and somewhat grooved. The flesh is thick and quality good, but with us it has not been at all productive.

No. 7. "Warren." This is a "turban" of the "Essex Hybrid" type—in fact, is a recent offspring of it, quite productive of large, cheese-shaped, warty, orange-colored fruits. The turban feature at the blossom end of the fruit is a source of weakness, as here the flesh is folded peculiarly, which favors decay. The flesh, quite thick in the stem half of the fruit, is deep orange at the center and pale orange toward the exterior.

No. 14. "Giant Neapolitan." This is a strong vine, producing fruits of great size, some three feet long and frequently bent. It is of the slender-stemmed group and its quality is not desirable.

No. 15. "Japanese" (No. 12843, U. S. A. D.) is apparently the same as our No. 31, figured in Plate XIII.

No. 16. "Mammoth Chili." This has a very large fruit, quite variable in size, but in general oval, without ribs and decidedly netted, like muskmelons.

No. 17. "Japanese" (No. 12845, U. S. D. A.) Practically the same as No. 30. The specimen shown in Plate XIII. is quite warty.

No. 18. "Winter Crookneck." This is a slender or hard-stemmed squash, producing large, striped fruits, with long, much-curved, solid necks. The flesh is thin, of a bright, light orange, with the quality inferior.

No. 19. "Cocoanut." A small squash, its size and shape being suggested in the name. It exhibits many variations, but in general the shape is oval with a sunken stem end and a blunt, pointed blossom end and somewhat corrugated, and of a cream color, striped in the grooves with yellow. At the stem end there is a disc with sharply-defined border, in which the yellow stripes are replaced by green. This last variation may be elsewhere upon the fruit in blotches upon one side. The flesh is a light yellow, with a small seed cavity and bearing small, oval, straw-colored seeds. The stem is long and very slender.

No. 20. "Victor." Produces a flat, orange-colored fruit, of small size.

No. 21. "Bay State." Is a somewhat cheese-shaped fruit, with a bluish-green color.

No. 22. Duplicate.

No. 23. "Golden Bronze." This is a squash of the "Hubbard" type, but broader, with green veining and shallow ribs.

No. 24. "Marblehead" is closely related to the "Hubbard," with a bluish color and oval shape. The quality is superior.

No. 25. "Dunlap's Marrow." Yields a fruit of the "Marrow" type, oval and often strongly ribbed and a beautiful solid orange color, with the surface finely netted, somewhat in stripes. The flesh is fairly thick, of rich orange, same as the exterior and with seeds long and white.

No. 26. "Warted Hubbard" is the ordinary "Hubbard," with a rough exterior. There was great variation in this wartiness among all the "Hubbards."

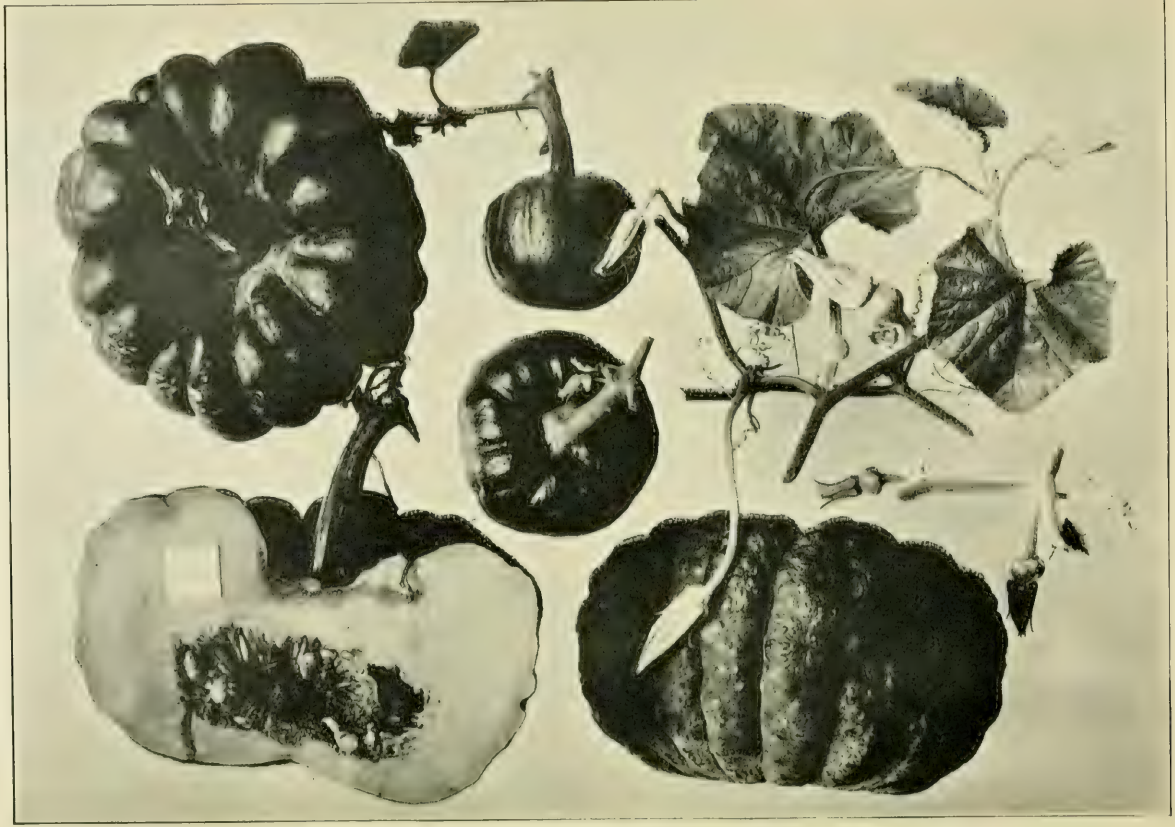

PLATE XIV.

A kind of Japanese Squash (31), No. 12844 U. S. D. A., is shown in various parts of vine, flower and fruit. The card upon the flesh surface is an inch square.

No. 27. "Canada Crookneck." As the name implies, the fruit has a long, crooked neck, like No. 18. When mature the fruits take on a dull cream color. The quality is not good.

No. 28. "Essex Hybrid," like "Warren" and "Bay State," is cheese-shaped and a turban, carrying the blood of the "Hubbard." The color is a cream pink and the fruit nearly smooth.

No. 29. "Butman." This produces a fruit of nearly the shape of the "Hubbard," but striped and netted light green upon a dark green background. Gregory states that this is a cross between the "Hubbard" and a Japanese variety. The flesh, of a light salmon color, is of high quality.

No. 30. "Faxon." The fruit is of a small type, flattish, nearly smooth, with no evident blossom tip, and the medium-sized stem sets upon the smooth upper end. In color it varies from cream orange to a light orange, with sometimes a darker orange showing through in fine streaks, especially at the blossom end. The flesh, comparatively thin, is a bright orange, and of the same thickness throughout the whole fruit. The white seeds are of medium size and shape.

No. 31. "Japanese" (No. 12844, U. S. D. A.) Four hills of this variety were grown upon the Gardens. (Plot 1, Series 1.) The vines showed unusual vigor and in time covered the whole ground and ran into the surrounding territory. From the start the character of the vine was quickly seen to differ from any of the American sorts grown elsewhere upon the gardens and new land. The leaf was angular, like the cucumber, and of medium size; the flowers, produced in profusion, were the largest of any sort under experimentation. They differ also in having the calyx, with long, slender or spatulate lobes (five and more) sometimes three inches long. The parts of the andnecium and gynæceum are more open than is usual in squashes and some flowers were with both sexes. These plants were not very fruitful, there being eight specimens, none of them over one foot across. The fruits are flat, deeply corrugated, with a glaucus green surface when mature. The flesh is a lively orange and quite thick, leaving only a small seed cavity and stringy placenta, somewhat like the field pumpkins in this last feature. The stem is long and slender and deeply set in the scalloped upper side of the fruit.

Plate XIV. shows a tip of a vine, with the leaves, and male and female flowers, also young squashes, which are nearly smooth and livid green, and mature fruits in three views. The card upon the cut flesh is an inch square, from which the size of the squash may be judged. The fruit is neither prolific nor handsome, and its quality is only fair. Several crosses were obtained between it and other vine and bush squashes. It is much less a favorite with the striped beetles than the "Hubbard" group, and no vines were troubled with other pests.

32. "Delicata." This variety is strongly marked by having the fruits small, oval, pointed, fluted, striped green and yellow and more or less mottled. The flesh is thick, orange-colored and of fine quality.

33. "Dauphne Pumpkin." This variety has a strong, running vine, but produced with us only a small number of small, oval, yellow, smooth fruits.

EXPERIMENTS WITH SALSIFY.

In order to study the colors of the flowers, the twelve rows were divided, by tall stakes, into sections of five plants each, and a record made for each plant. The following chart is for the first fifty plants. When the plants failed to bloom or to produce flowers that were normal, the space is left blank. The abbreviation "alb." indicates that the plant was an albino, and "y" indicates that the central flowers of the head were yellow. The "Prang Standard Scheme" was used.

Color Chart of Hybrid Salsify (Plot 3, Series VI.)

Row:	1	2	3	4	5	6	7	8	9	10	11	12
Plant.												
1	31	91	81y	93	333y	..	..	..	..	334	93	..
2	..	333	224	93	41	333y	233	..	21	12	93	234
3	253y	..	233	41y	234	83	..	..	83	..	93	93
4	..	93	333y	93	31y	..	..	..	..	..	..	93
5	333	234y	93	..	93	93	224	93	..	..	224	93
6	234y	253y	..	93	..	325	333y	61y	..	..	224	41
7	253y	224	223	21y	..	41y	..	234	..	..	..	31
8	93	61y	385	242	..	21y	..	333	325	..	21y	355
9	93	224	41y	94	93	333	..	334	93	..	..	333
10	95	93	..	242y	225	333	31	..	242y	234	93	41
11	333	..	333	234	41y	93	93	..	242y	333	..	92
12	..	224	224	..	41y	..	333y	325	335	..	234	333
13	93	224	233y	..	234	..	31	93	93	333	..	234
14	93	93	93	333	..	234	224	93	93	333	..	93
15	33y	334	..	255y	234	..	93	224	93	93	93	234
16	224	233y	95	21y	333y	225y	..	93	..	..	..	234
17	..	333	41y	95	93	84	93	..	..	21	41y	234
18	..	234	..	93	alb.	93	224	224	41y	..	333y	93
19	..	93	94	233	224	93	41y	..	333	..	..	..
20	31	82y	93	41y	..	234	..	..	..	225	..	234
21	12	..	..	21y	93	234	..	93	..	..	21	41
22	..	93	233	205	233	..	21	alb.	21	alb.	224	234
23	..	375	..	234	41y	..	325	333	82y	93	..	..
24	..	72	224	93	93	31	224y	..	..	..	93	92
25	333	21	224y	93	93	..	93	..	..	225	234	..
26	93	333	224y	233	93	333	41	93	93	41y	..	..
27	..	..	93	93	224y	..	..	253	..	234	234	255
28	..	..	93	242	93	93	234	..	224	41y	93	93
29	..	233y	12	alb.	..	..	..	..	alb.	..	385	..
30	..	333	242	93	334y	333	224	..	224	..	234	234
31	223	94	225	..	..	93	93	234y	alb.	..	..	21
32	93	21y	334	..	234y	233	..	..	12	234	93	234
33	223	224y	334y	82y	41y	242y	..	93	..	93	61	333
34	..	233	333	21y	31	93	333	333	41y	..	385	333
35	224	224	..	233	93	333	..	333y	..	234	234	234
36	41y	222	234	223y	93	93	31	31y	93	..	alb.	12
37	254	95	234	..	233y	31y	93	..	233	333	93	234
38	93	234	alb.	..	..	41y	333	..	..	31	21	93
39	93	234	333y	..	93	333	93	333	234	31	21	234
40	242y	alb.	..	12	333y	93	93	224	..	225	234	12
41	93	333	41y	234	21y	..	93	93	..	333	224	31
42	225	93	93	93	21y	234	..	233	..	334	..	..
43	93	..	333	333	243	93	93	234	333	..	224	..
44	253	224y	12	242	..	234	243	21	..	..	..	93
45	226	333y	242	224	..	93	95	93	..	..	31	93
46	93	92y	333y	85y	41y	224	..	93	..	234	224	234
47	93	93	242y	..	93	224	..	234	234	234	325	225
48	12	224y	93	93	21	41y	..	385	93	234	..	234
49	41	234y	alb.	242	234	333y	..	..	21	..	93	41y
50	91	224	234	41y	31	31y	..	234	93	..	234	41y

From the above table the following summary of colors is drawn:

	12.	Dark red	9
	21.	Dark red red orange	11
	21.	“ “ “ “ (yellow center)	10
	31.	Darker red orange	13
	31.	“ “ “ (yellow)	4
	33.	Red orange (yellow)	1
	41.	Darker orange red orange	6
	41.	“ “ “ “ (yellow)	23
	61.	Darker orange yellow orange	1
	61.	“ “ “ “ (yellow)	2
	72.	Dark yellow orange	1
	81.	Darker yellow yellow orange	2
	82.	Dark yellow yellow orange (yellow)	3
	84.	Light yellow yellow orange	1
	85.	Lighter yellow yellow orange	1
	91.	Darker yellow	2
	92.	Dark yellow	2
	92.	“ “ (yellow)	1
Parent	93.	Yellow	109
	94.	Light yellow	3
	95.	Lighter yellow	5
	205.	Lighter violet blue violet	1
	222.	Dark violet red violet	1
	223.	Violet red violet	3
	223.	“ “ “ (yellow)	1
Parent	224.	Light violet red violet	28
	224.	“ “ “ “ (yellow)	7
	225.	Lighter violet red violet	7
	225.	“ “ “ “ (yellow)	1
	233.	Red violet	12
	233.	“ “ (yellow)	3
	234.	Light red violet	49
	234.	“ “ “ (yellow)	4
	242.	Dark red violet	6
	242.	“ “ “ (yellow)	6
	243.	Red red violet	2
	253.	Orange gray (brown)	1
	255.	Lighter orange gray	1
	255.	“ “ “ (yellow)	1
	325.	Lighter gray	5
	333.	Red gray (russet)	34
	333.	“ “ “ (yellow)	14
	334.	Light red gray	6
	334.	“ “ “ (yellow)	3
	353.	Yellow gray (citrine)	1
	353.	“ “ “ (yellow)	3
	354.	Light yellow gray	1
	355.	Lighter yellow gray	1
	375.	Lighter blue gray (slate)	1
	384.	Light violet gray (heliotrope)	1
	385.	Lighter violet gray	4

It is seen that the number most in evidence is 93, the wild yellow parent, and the next is No. 234, followed by No. 333, and the cultivated violet parent type is fourth.

Salsify in the Old Plot.

Hybrid salsify has been left to take care of itself for five years upon one half-plot of the Experiment area.

During the present year the record for the colors and the number of plants for each color or shade is as follows:

No.	12.	Dark red	5
“	12.	“ “ yellow	4
“	21.	Darker red red orange	4
“	21.	“ “ “ “ yellow	4
“	31.	Darker red orange	8
“	31.	“ “ “ yellow	12
“	32.	Dark red orange	1
“	41.	Darker orange red orange	2
“	41.	“ “ “ “ yellow	11
“	51.	Darker orange	1
“	51.	“ “ yellow	3
“	82.	Dark yellow yellow orange yellow	2
“	83.	Yellow yellow orange yellow	1
“	91.	Darker orange	1
“	91.	“ “ yellow	3
“	93.	(Parent) Yellow	220
“	94.	Light yellow	19
“	95.	Lighter yellow	1
“	224.	(Parent) Light violet red violet	12
“	224.	Light violet red violet	9
“	225.	Lighter violet red violet yellow	1
“	253.	Orange gray yellow	1
“	333.	Red gray	39
“	333.	“ “ yellow	46
“	335.	Lighter red gray	1
“	335.	“ “ “ yellow	2
“	354.	Light yellow gray	1
“	354.	“ “ “ yellow	2
“	355.	Lighter yellow gray yellow center	1

It is seen that out of 417 plants recorded in the area, 220, or a little more than half, are of the type of the yellow parent—that is, the wild species (*Tragopogon pratensis* L.)—while less than one-tenth as many were of the color of the cultivated species (*T. porrifolius* L.) The reason for this may reside in the greater seeding capacity and vitality of the yellow type.

It is to be noted that the number of those heads with yellow centered flowers—the ray blossoms having some other color—is very large, so that all together the yellow color is by far the leading one for the heads that are not yellow throughout.

At the time (June 14th) when the plants were maturing the seeds, a number of heads, one from a plant, gathered at random, gave the following results, in terms, of good and abortive fruits (seeds):

No.		Sound.	Abortive.
12.	Dark red	7	63
12.	" " (yellow)	1	74
21.	Dark red red orange (yellow)	21	19
21.	" " " " "	22	32
31.	Dark red orange (yellow)	26	34
31.	" " " "	42	19
31.	" " " "	8	49
41.	Darker orange red orange (yellow)	26	42
41.	" " " " "	10	52
41.	" " " " "	15	37
82.	Dark yellow yellow orange (yellow)	26	42
82.	" " " " "	6	43
93.	Yellow (average of eighteen)	42	17
224.	Light violet red violet	46	10
224.	" " " "	47	11
224.	" " " " (yellow)	13	58
224.	" " " " "	13	30
224.	" " " " "	12	41
234.	Light red violet (yellow) (average of eight)	11	44
255.	Lighter orange gray (yellow)	4	48
333.	Red gray	10	59
333.	" " (yellow)	13	37
333.	" " "	14	59
333.	" " "	9	52
333.	" " "	25	25

It is noted that the number 93 leads with twelve, while No. 234(y) comes next, with eight. A striking difference between these two sets is seen in the number of sound and abortive seeds. The 93 gives an average of 42 sound and 17 abortive seeds, while 234(y) has 11 sound and 44 abortive seeds.

At another time all the heads upon five plants were considered, with the following results:

Plant 1.	No. 93.	Six heads	Average sound, 20;	abortive, 41
" 2.	" 253.	Four heads	" " 65	" 2
" 3.	" 93.	Five heads	" " 59	" 4
" 4.	" 333y.	Six heads	" " 7	" 64
" 5.	" 234.	Six heads	" " 31	" 36

Observations upon Salsify.

All blossoms open and close at about the same time, remaining open longer on a cloudy day than in the bright sun. Those kept under a bell jar remained open the whole day, the others closing from 9:30 to 11:30, according to the weather. A flower opens two or three times and it takes two weeks, or a little more, for the seed to mature. The color of the flowers varies from yellow, through orange and red, to a violet purple. The new plot is planted after this arrangement. The color 333 includes several shades. The yellow centers are more abundant in the orange and orange yellow flowers than in those more nearly approaching the violet. In the latter the "yellow" is very light, sometimes almost white. The flowers, especially the violet ones, faded in successive openings. Some of the flowers designated as "yellow centered" were only mottled with yellow, the amount varying from slight mottling to a pure yellow. This did not occur in the more violet flowers. There is great variation in the shape and general appearance of the plants, to which but little attention has been paid.

The black salsify is not usually self-fertile. The colors vary greatly in seed-producing capacity, but this is not a variation in the number of ovules formed, but in the number fecundated. In general, the colors more nearly like the parents produce the most seeds.

EXPERIMENTS WITH WEEDS.

After nine years, in July, of the present season, the weed experiment was brought to a close. The weeds left uncared for had a bad effect upon trial plants in the land bordering upon the untilled ground. The outer portion of the weed land offered unusual conditions for the growth of such plants as the sweet clover (*Melilotus alba* L.), which grew to great size and overshadowed many kinds of weeds that were located more centrally. One end of the ground became almost entirely covered with an aster (*Aster paniculatus* Lam. (?)), while in the opposite end a wild cherry (*Prunus serotina* L.) tree had attained a height of fifteen feet and was making a dense shade, inimical to the weed experiment in that locality. The middle of the weed plot had become overgrown with wild grapevines, which were fast choking out the other plants. The end it was not difficult to forecast, namely, the aster covering a portion of the area exclusively; a large cherry tree, with its wide-spreading limbs close to the ground, and the tangle of grapevines climbing over it at one end of the plot, with the asters and the grapevines at the other. The longlived plants had won in the struggle for the possession of the soil.

Notes taken upon the weed belt upon June 26th record that the strongest growing weeds were the melilot, along the border, and the aster and grapevines within. A bromus (*B. ciliatus* L.) was abundant, and the following fruiting weeds were in evidence: "Yellow Rocket," "Dock," "Sorrel," "Ox-Eye," "Carrot" and "Oxalis." Two weeks later (July 10th) there were, in addition, "Fleabane," "Goldenrod," "Smartweed," "Plantain," "Bindwood," "Dandelion" and "Catch-fly." Various clovers, bluegrass and ragweed were to be found.

On account of the discontinuance of the experiment in the middle of the weed season, it is not possible to give a rank to the species the present year. It is not likely that it would differ materially from that of last season, which, with the seven preceding it, are given below:

Botanical Name.	Common Name.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
Aster paniculatus Lam. (?)	Aster	..	..	..	..	..	13	7	1
Ambrosia artemisiæfolia L.	Ragweed	3	5	1	1	14	12	13	2
Polygonium Pennsylvanicum L.	Smartweed	6	3	2	2	4	4	6	3
Melilotus alba Lam.	Sweet Clover	..	..	..	12	10	10	4	4
Oxalis stricta L.	Oxalis	..	..	..	8	11	11	12	5
Rumex acetosella L.	Sorrel	..	7	4	3	1	1	1	6
Plantago Rugelii L.	Plantain	..	..	12	..	..	..	..	7
Abutilon Abutilon L.	Velvet Leaf	7	2	6	6	3	5	11	8
Ixophorus glauca (L.)	Foxtail Grass	..	..	..	7	..	..	..	9
Bromus ciliatus L.	Brome Grass	..	..	..	..	..	..	..	10
Daucus carota L.	Wild Carrot	12	..	..	4	5	2	2	11
Barbarea Barbarea (L.)	Yellow Rocket	..	..	..	11	..	..	..	12
Bidens frondosa L.	Beggars' Ticks	..	..	..	..	..	..	..	13
Acalypha Virginica L.	Mercury	..	..	..	..	..	..	..	14

It is seen that four of the species that were in the first list (1897) are still among the first fourteen, and it is to be observed that the ragweed holds nearly the same rank this season as it did eight years before. It has been first on the list for two years, and in 1901 it was the last to get a record. It is also to be noted that a rank-growing aster came in two years ago, and has gone rapidly to the first place.

The experience of the nine years suggests that there are many things that may interfere with the prevalence of any weed, not the least of which are qualities within the species, which, however, may be dominated by the characteristic of those weeds that are contending for supremacy. Under the conditions of the experiment the perennial species gained the upperhand, and doubtless, in the long run, the land would have become forest clad.

NOTES UPON ORNAMENTAL PLANTS.

The white-fringed phlox was grown for its third season, and some seed of this interesting cross has been saved and young plants started for next year's study.

Seeds of the morning glories that had been "hand-pinched" for nine generations were grown for two generations in the Gardens. With the aid of the greenhouse, in winter, three crops can be procured in a year. The experiment of removing the tips of the stalks results in bushy plants that produce an abundance of flowers near the ground. Last winter a plant only a foot high thus treated bore four full-sized flowers at the same time and a photograph was secured of it. The tendency to twine was very strong in the plants in the open, and unless closely watched the neglected plants will attain to great height. As all the plants under treatment were of the same stock, the flowers, often showing in hundreds, were with exactly the same markings.

Some attention was paid to the evening primroses and hybridization was attempted with several species. The species *Oenothera Lamarckiana* Ser., in which Dr. De Vries has found so many "mutants"—that is, strongly-marked forms that he calls new species—has been grown in some quantity, and one plant among them showed a marked deviation from the type.

The study of varying forms led to the setting out of a long row of the common dandelion, all gathered from the paths of the Gardens, and each of the twenty plants showing a marked difference from any of the others. In like manner a row of daisies was transplanted from a neighboring field, each of the dozen plants being of a quite distinct form from the others. One of these was so peculiar as to have all the ray flowers, although white, of the tubular shape of the yellow ones in the center of the head.

A large amount of cross-pollinating was done between the "Marsh Mallow," growing in the Gardens, and the "Rose of Sharon," in neighboring grounds. Perhaps two per cent. of the seed capsules of the hand-worked blossoms remained intact and produced seed. In this instance the union, if secured, is between a stout, herbaceous perennial that dies to the ground in autumn and a shrub of the ordinary type.

Work is in progress for increasing, by selection, the percentage of foxglove plants that produce the large, bell-shaped blooms as a monstrosity at the ends of the flowering stems.

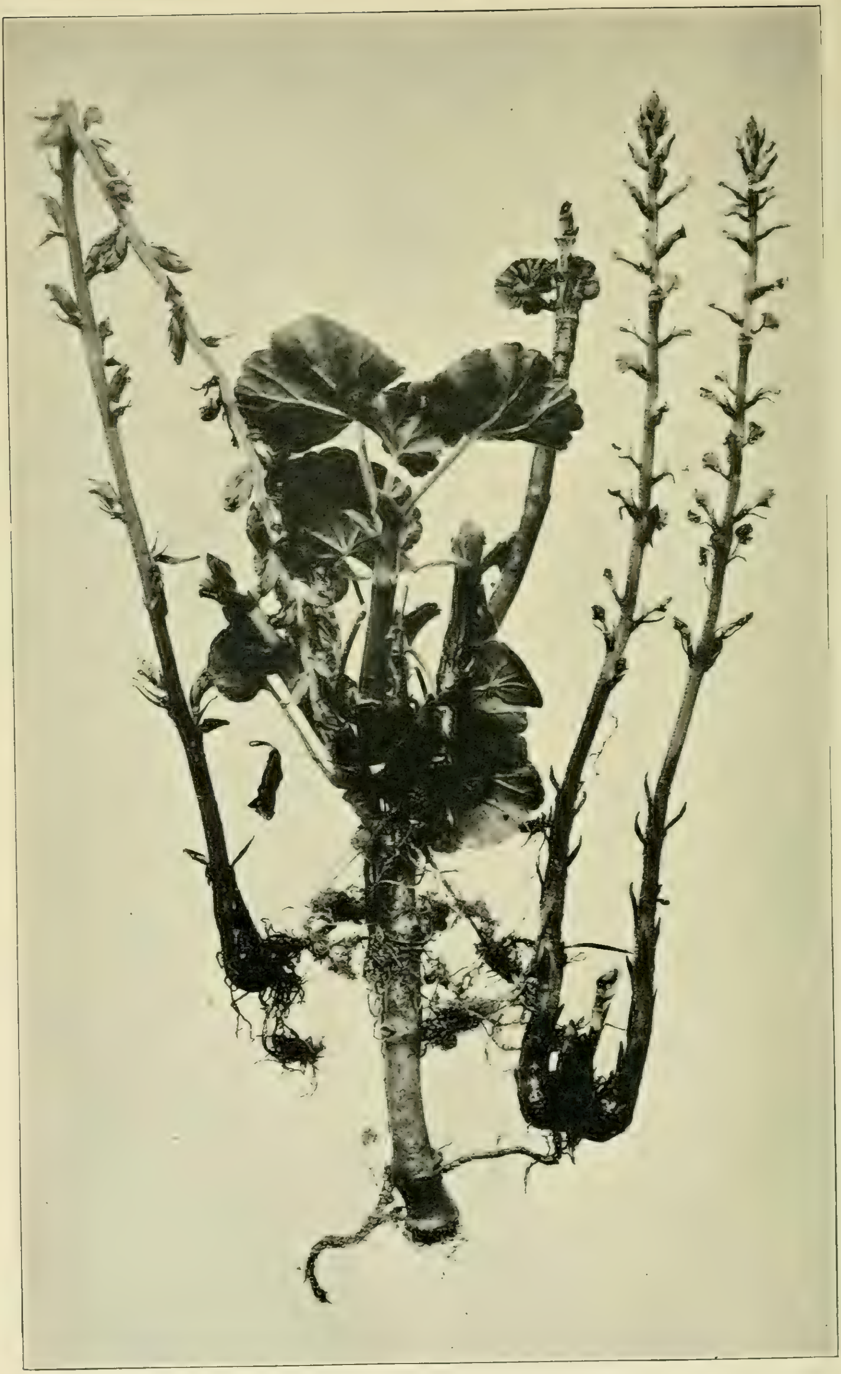

PLATE XV.

Broom Rape (*Orobanche minor* L.) upon common "Geranium" grown in the greenhouse.

A number of crosses were probably obtained between various varieties or species of ornamental plants. This portion of the work is an aside, although one that may be as important as it is interesting.

BROOM-RAPE UPON PELARGONIUM.

The common "geranium" (pelargonium) is quite immune to attacks of the lower forms of parasite, and insects are not troublesome upon this truly popular ornamental plant, whether in the foliage and flower beds in summer or in the window and conservatory in winter. It is a matter for record, therefore, that among the few plants grown in the greenhouse last winter one should have been attacked by a broom-rape, which, when it had attained its full size, was larger than the "geranium" upon which it grew. It is the species known as *Orobanche minor* J. Esm, and has for its more general hosts the members of the pea family, and in this locality is frequently met with upon the red clover. Plate XV. shows some of the peculiarities of this parasite, including its attachment to the geranium plant.

The seed of this parasite germinates in the soil and the young roots attach themselves to those of the "geranium," after which it seeds up above ground a purplish, erect stem, bearing small, scale-like leaves of the same color, and later on a number of blooms scattered quite uniformly along the unbranched stem. The absence of green in the sun-exposed parts marks this plant as a parasite, and a close inspection of the roots shows that it gets its nourishment from another plant of the ordinary self-supporting type. In the present instance the "geranium" cuttings failed to flourish, and the cause of the sickly appearance was not far to seek so soon as the parasite pushed its stems above the ground, which resembled the tips of young asparagus shoots as they came through the soil, although the broom-rape is somewhat smaller.

There is one other broom-rape that has been in evidence in the greenhouse, namely, the *Orobanche ramosa* L., the hemp broom-rape, which grows to some extent upon the tomato plants—in fact, there were specimens of the two species in sight at the same time, and had there been the desire a hybrid possibly might have been secured between the two, with results as to the relation to host plants that are left for the imagination to supply.

FUNGI AS RELATED TO WEATHER.

The following items concerning crop plants are gathered from the "Weather and Crop Bulletins," issued weekly by the State Weather Service, during the months of April to September of the present year:

April 11th—"Wheat much winter killed."

April 25th—"Much clover winter killed;" "Raspberries somewhat winter killed;" "Strawberry blooms killed;" "Some vines winter killed."

May 2d—"Some raspberry and blackberry vines winter killed;" "Crimson clover mostly winter killed;" "Large portion of peach and early strawberry bloom killed by frost."

May 16th—"Clover wilting;" "Clover wilting."

May 23d—"All fruit trees, especially cherries, begin to show effects of recent cold winds; one-half of the blossoms blasted;" "Plums have dropped badly."

June 13th—"The severe winter weather killed all the quince and persimmon and injured the peach and papaw trees;" "Apples dropping;" "Cherries dropping;" "Some apples dropping in places."

June 20th—"Cherries rotting;" "Cherries rotting;" "Apples full and little dropping."

June 27th—"Cherries rotting badly;" "Apples dropping badly;" "White cherries rotting;" "Apples and pears dropping."

July 5th—"All peach trees in this section killed by the severe winter weather;" "Cherries rotting;" "Apples and pears dropping;" "Tomatoes badly blighted in some places;" "Apples and peaches dropping;" "Apples dropping badly;" "June drop of apples seems excessive in places;" "Early apples dropping badly."

July 11th—"Peaches dropping;" "Apples dropping;" "The Irish cobble potato especially affected by blight of tops;" "Apples dropping."

July 18th—"Apples dropping;" "Apples, peaches and plums dropping;" "Potatoes show signs of blight;" "Tomatoes excellent, only little blight."

July 25th—"Corn rolling;" "Apples dropping;" "Apples dropping fast;" "Fruit dropping;" "Corn rolling;" "Corn rolling badly;" "Corn rolling badly;" "Corn rolling;" "Corn rolling badly;" "Apples dropping badly;" "Apples and peaches dropping;" "Garden truck wilting;" "Corn rolling;" "Corn rolling, wilting in some fields;" "Corn rolling;" "Potatoes blighting, many fields dead;" "Corn is rolling;" "Corn rolling;" "Tomatoes scalding;" "Corn rolling;" "Winter apples dropping badly;" "Apples dropping badly;" "Early potatoes and tomatoes blighting;" "Fruit dropping;" "Vegetation wilting on hot days;" "Potato vines dying."

August 1st—"Apples continue dropping;" "Apples and pears dropping;" "Corn rolling;" "Potato vines dying;" "Apples dropping badly;" "Corn rolling;" "Apples dropping;" "Apples dropping;" "Apples drop heavy;" "Corn rolling badly;" "Apples dropping;" "The fatal 'brown spot' blight has begun on some unsprayed citron vines, with the citrons far from mature;" "Apples dropping."

August 8th—"Potatoes seriously affected, vines dying;" "Potatoes affected by blight;" "Apples dropping;" "Corn is rolling in places;" "Apples dropping;" "Corn rolling;" "Apples dropping;" "Corn rolling badly;" "Apples dropping;" "Early planted corn turning yellow;" "Citron vines wilting;" "Club root severe in some fields of cabbage;" "Corn drying up;" "Apples dropping considerably;" "Late cabbage seriously shortened by blight;" "Corn is scalding on light soil."

August 15th—"Apples dropping;" "The black rot is seriously shortening the tomato crop in this vicinity;" "About one-third of the apples have fallen from the trees;" "Apples dropping;" "Grapes rotting;" "Apple dropping continues on some trees;" "Apples dropping;" "Corn has scalded badly."

August 22d—"Tomato rot continues;" "Grapes rotting;" "Apples dropping;" "Apples dropping;" "Apples continue dropping;" "Tomatoes will be a light crop owing to blight;" "The tomato crop, for canning purposes, will, except in a few places, be below the average, principally owing to scald;" "Citron blight is slower than in former years;" "Apples continue dropping;" "Citrons and tomatoes blighting."

August 29th—"Tomatoes injured by black rot;" "Apples continue dropping;" "Plums much rot;" "Apples dropping;" "Tomatoes and grapes rotting badly;" "Late corn blighting in some fields."

September 5th—"Tomatoes do not ripen and are decaying badly;" "Apples continue dropping;" "Corn somewhat injured by rust;" "Early potatoes rotting."

September 12th—"Potatoes very poor in this section, owing to blight;" "Grapes rotting;" "Tomato leaves blighting rapidly;" "Corn cutting progressing, owing to so much scald the yield will not be as large as expected."

The crops mentioned in the above reports are here arranged alphabetically, thus showing the number of times a specific trouble is mentioned. The numeral in parentheses indicates the times the same disease is reported for the given date:

Apples—June 13th, dropping (2). June 20th, dropping. June 27th, dropping badly; dropping; July 5th, dropping (2); dropping badly (2); drop. July 11th, dropping (2). July 18th, dropping (2). July 25th, dropping (2); dropping fast; dropping badly (3). August 1st, dropping (6); dropping badly; drop heavy. August 8th, dropping (5). August 15th, dropping (4); about one-third have fallen. August 22d, dropping (4). August 29th, dropping (2). September 5th, dropping.

Blackberry—May 2d, vines winter killed.

Cabbage—August 8th, club root severe; blight.

Cherries—June 13th, dropping. June 20th, rotting (2). June 27th, rotting badly; rotting. July 5th, rotting.

Citron—August 1st, "brown spot" blight. August 8th, wilting. August 22d, blight; blighting.

Clover—April 25th, winter killed. May 2d, winter killed. May 16th, wilting (2).

Corn—July 25th, rolling (9); rolling badly (3); wilting. August 1st, rolling (2); rolling badly. August 8th, rolling (2); rolling badly; turning yellow; drying up; scalding. August 15th, scalded badly. August 29th, blighting. September 5th, injured by rust. September 12th, scald.

Fruit—May 23d, tree blossoms blasted. June 13th, quince and persimmon winter killed and peach and papaw trees injured. July 25th, dropping (2).

Grapes—August 15th, rotting. August 22d, rotting. August 29th, rotting badly. September 12th, rotting.

Peach—May 2d, peach bloom killed by frost. July 5th, peach trees winter killed; peaches dropping. July 11th, dropping; July 18th, dropping; July 25th, dropping.

Pears—June 27th, dropping. July 5th, dropping. August 1st, dropping.

Plums—May 23d, dropped badly. July 18th, dropping. August 29th, rot.

Potatoes—July 11th, blight. July 18th, blight. July 25th, blighting (2); dead; vines dying. August 1st, vines dying. August 8th, vines dying; blight. September 5th, rotting. September 12th, blight.

Raspberries—April 25th, winter killed. May 2d, vines winter killed.

Strawberry—April 25th, blooms killed. May 2d, bloom killed by frost.

Tomatoes—July 5th, badly blighted. July 18th, blight. July 25th, scalding; blighting. August 15th, black rot. August 22d, rot; blight; scald; blighting. August 29th, black rot; rotting badly. September 5th, decaying badly. September 12th, leaves blighting rapidly.

Truck—July 25th, wilting.

Vegetation—July 25th, wilting.

Vines—April 25th, winter killed.

Wheat—April 11th, winter killed.

Rainfall of the Growing Season for Past Sixteen Years.

	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	Average.
April	5.32	2.65	2.19	2.49	5.21	3.09	4.88	1.35	3.79	3.74	1.73	2.29	6.31	3.62	3.97	3.43	2.88	3.45
May	4.09	4.24	2.97	5.04	4.07	7.72	2.85	3.21	5.68	7.00	1.92	4.71	5.60	2.04	0.59	2.60	1.71	3.88
June	3.73	3.59	2.92	3.85	2.95	2.28	3.24	5.46	3.38	2.10	2.50	3.08	1.57	6.57	7.68	3.13	3.43	3.62
July	10.19	5.62	5.30	4.03	2.72	1.66	4.26	5.50	11.42	4.96	5.75	4.74	5.87	4.78	5.51	4.87	4.06	5.38
August	5.18	4.90	5.32	3.63	6.52	2.58	1.83	4.39	5.36	4.36	2.68	9.43	3.91	6.95	6.95	6.62	5.72	4.24
September	8.36	4.75	2.46	1.81	3.30	7.46	1.07	4.37	1.65	2.00	5.88	2.86	3.38	5.65	3.34	4.79	5.23	4.01
Totals	36.87	25.75	21.16	20.85	24.67	24.79	18.83	21.72	30.31	25.16	22.14	20.36	32.16	26.57	28.04	25.43	23.03	24.58
Average	6.14	4.30	3.53	3.47	4.11	4.13	3.14	3.62	5.05	4.19	3.69	3.39	5.36	4.43	4.67	4.27	3.84	4.09
Rank in wetness......	1	6	14	15	10	9	17	13	3	8	12	16	2	5	4	7	11	...
Rank in dryness......	17	12	4	3	8	9	1	5	15	10	6	2	16	13	14	11	7	...

Temperature of the Growing Season for Past Sixteen Years.

	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	Average.
April	51.2	50.4	52.0	49.3	49.2	50.3	49.1	52.4	50.4	47.8	49.9	50.8	48.3	50.2	50.9	46.7	49.9	49.3
May	62.3	60.7	59.5	60.1	59.4	61.4	60.9	65.3	60.6	58.5	61.1	60.9	58.6	60.3	62.7	62.8	61.4	60.9
June	69.9	70.7	69.7	72.4	69.7	70.6	71.7	68.1	66.1	70.1	72.3	70.4	70.0	67.5	64.0	68.6	68.3	69.3
July	73.4	72.5	70.1	74.3	73.9	75.7	70.9	75.0	74.1	75.3	74.7	75.9	77.3	73.0	73.3	72.3	74.4	73.9
August	69.6	71.5	72.8	73.4	72.8	70.9	74.2	73.6	71.0	74.8	72.3	76.3	73.8	70.1	68.4	70.8	71.1	72.1
September	64.8	64.4	68.7	64.2	62.7	68.3	69.7	65.1	65.5	68.6	64.4	69.9	66.8	64.6	65.0	64.8	65.4	65.9
Average	65.2	65.0	65.4	65.6	64.6	66.2	66.1	66.6	64.6	65.9	65.8	67.4	65.8	64.3	64.0	64.3	65.1	65.2
Rank in warmth	11	12	9	8	13	3	4	2	14	5	6	1	7	15	17	16	10	...
Rank in coldness	7	6	9	10	5	15	14	16	4	13	12	17	11	3	1	2	8	...

Sunshine of the Growing Season for the Past Sixteen Years in Percentage of Clear-Partly-Cloudy Days.

	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	Average.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
April	53	76	80	53	60	70	60	76	83	62	87	77	50	70	66	70	77	70.1
May	65	66	64	71	69	65	78	71	78	52	77	75	58	84	84	84	74	70.9
June	66	80	76	76	70	83	73	73	80	87	84	80	87	83	53	77	77	76.8
July	58	76	69	84	87	84	78	74	68	74	77	87	71	71	84	74	81	76.4
August	74	77	61	78	81	80	90	87	84	77	71	84	71	90	65	81	74	77.9
September	53	66	83	87	73	66	90	70	87	83	80	80	80	60	83	80	76	76.4
Average	61.5	73.5	72.2	78.2	73.3	74.7	78.2	75.2	80.0	72.7	79.3	78.9	69.5	76.3	72.7	77.7	76.5	74.7
Rank in brightness	17	16	15	4	12	10	5	9	1	13	2	3	16	8	14	6	7	...
Rank in darkness	1	7	3	14	6	8	13	9	17	5	16	15	2	10	4	12	11	...

The rainfall has been somewhat below the average during the growing season, due in large part to the very dry weather that prevailed in April, and particularly through the month of May, when only 1.71 inches fell, as against the normal of nearly four inches. August and September were the only months which were above the average, the former exceeding the normal by an inch and a half. As July was near the normal, it is seen that the season was divided into a dry first half and a second half that was somewhat above the average in precipitation. These conditions were unfavorable for all early crops, but the later rains and the absence of frosts made amends for this in the summer and autumn months.

Among the seventeen years recorded in the table the growing season of 1905 ranks eleventh for wetness, and therefore seventh for dryness, and, taken as a whole, is very near the average for the whole group of years named.

In temperature the growing season of 1905 was, as a whole, quite close to the normal, it being only one-tenth of one degree below the average for the last seventeen years. It was above the average for April and May—that is, during the dry period; exactly normal for June and above for July, normal for August and a little below the average for September. In warmth it ranks tenth among the seventeen years that the writer has been in charge of the department.

The tables for sunshine are not so easily constructed as for rainfall and temperature, but the estimates show the growing season was somewhat brighter than the average. Its rank is seventh among the past seventeen seasons.

If dryness, warmth and clearness are considered, it is found that the rank for each for the past season is seventh, tenth and seventh, respectively. It is to be observed that the temperature of the seventh and tenth in rank differ only in one-half of one degree, so that there is essentially a close relationship between the dryness, warmth and clearness of any season. Thus the season of greatest rainfall in the whole seventeen, namely, 1889, is the darkest, but there were some others that were somewhat colder. Thus the season of 1900 was, in dryness, warmth and sunshine, second, first and third, respectively.

When the facts concerning the fungous diseases, as reported by the weather crop correspondents, are compared with those of previous seasons and with the weather for the same period, it seems evident that there is a close relationship between the two sets of phenomena.

Fungi upon the Experiment Grounds.

Upon the Gardens the fungous diseases most in evidence were the mildew (*Phylophthora Phaseoli*) upon the lima beans. It seemed to attack both the pole and bush sorts nearly equally, but of the latter the small, thin-podded sorts, like "Jackson Wonder," were the least affected. The pod-spot (*Coletotrichum*) was in evidence, both in the spring and autumn crop, but particularly so with the latter crop. For the first time, to be at all serious, the bean rust (*Uromyces appendiculatus*) developed upon the crop in the Gardens. Upon this account, and as there were many varieties exposed, a study was made as to the susceptibility of the different sorts. Many were entirely free from the rust; several had it only upon the stems or foliage, while others, always of the green-podded group, showed it badly upon the pods, and such varieties as the "Tennessee" were nearly ruined. The sweet corn showed some smut, which was much more abundant upon the "Malakhov" than elsewhere. The same report has come in from several growers throughout the State. The tomatoes were quite free from all troubles, excepting a variegation of the foliage, resembling a disease in tobacco—a closely related plant to the tomato—which has taken the name of "Mosiac." This yellowing, in spots, of the leaves seemed to be inherent in the young plant, and it was not observed to spread to other plants in the field. The eggplants were quite free from leaf blight, excepting the "Scarlet Chinese," the foliage of which became very spotted toward the close of the season.

Asparagus Rust.—The rust upon the asparagus has not been as abundant this season as in some former years. This may be due, as some large growers claim, to the general use of the more resistant varieties, as the "Palmetto" and "Argenteuil," or French sorts.

REMOVING AND PRESERVING SEEDS.

In the saving of squash seeds, that are easily moved by the wind and thus liable to mixing when several crosses are spread out to dry, it has been found convenient to place the washed seeds—the poor ones having been floated off—in roomy bags of mosquito netting, fastened (tied) with the same wire-wood label that was removed from the hand-worked squash, with all its items of record. Such loose bags permit of the seeds being spread out upon the drying frame of lath, made with wide spaces between the strips, where they can be readily turned until fully dry. They are readily stored in the same bags in the tin boxes arranged in pigeon-hole cases.

The finer mesh of mosquito netting has been used for the drying of eggplant seed, which otherwise is easily blown away or might become mixed with other crosses.

In the harvest of small quantities of beans the seeds are beaten out with a short stick upon a sail cloth, from which the seeds are gathered and placed in mosquito netting bags and hung by the wire label to horizontal wires. Lima beans in the small quantities are, after drying in the mosquito netting bags of large mesh, placed in gunny sacks and beaten as the other beans, without the danger of loss or mixing by flying as when uncovered.

The method of securing and preserving the tomato seed is as follows: The mature fruit, with the broken paper bag still perhaps half surrounding it and making the "crossed fruit" easily found, has its thoroughly washed seeds spread upon a sheet of paper, eight and one-half by eleven inches in dimensions, to which the contents of the label are transcribed and any other desired notes. Where the case seems to demand it the fruit, when cut in halves, is outlined upon the sheet with a sketch in detail of the interior structure. The natural mucilage of the seeds causes them to adhere securely to the sheet, which can be pinned with those of its own "family" and kept in tin boxes out of reach of mice. At planting time each sheet to be used is turned bottom side up and given a sharp snap to insure the removal of any seed that might possibly have become detached and got out of place. The removal of the seeds from the sheet for planting is a partial record of the fact through the "scars" that are left upon the paper. However, the pencil is needed to add the date, number of seeds removed, etc.

NOTES UPON THE KEEPING OF RECORDS.

The question frequently arises as to the possibility of keeping the progress of breeding experiments closely in hand, so that the one in charge may at a glance know the history of the plants he is dealing with then and there. It is doubtless true that the perfect system of making records is still to be formulated, and as yet, in a measure, each breeder is working upon somewhat independent lines that, while necessarily agreeing in essentials, vary greatly in details.

Blank books, five and one-half by eight and one-half inches and one inch thick, are now more used than the smaller sizes in vogue during the earlier years. Certain of these books are with an alphabet leaf index, giving a half-dozen or so of pages to each letter. Other books of the same size are without the index. The following is a sample of the title of one of the books for the present season: "Tomato Crosses—Gardens, 1905." In this a third of a double page is given to each cross. The left-hand page of the double page records the historical portion of the cross and the other facts, that are given in contracted form, while upon the right-hand page more general observations are written out. To illustrate:

$\dfrac{123}{\dfrac{85,}{\text{II.}}}$ **3/25.5.8/31 St. Fl. R. S. M. Rd.**

This means that the variety "Stone" (123) was crossed upon "Michigan" (85), and the Roman numeral II. below the fraction bearing the variety numbers shows that this is the second generation of that cross. The row of five plants was set in the Gardens upon March 25th (3/25). The five (5) plants all did well enough to be considered in the test, and upon August 31st (8/31) the following general observations were made: The plants were all of the standard (St.) type, with foliage of the fine-leaved (Fl.) sort. The fruits were round (R.), smooth (S.), medium (M.) in size and of a red (Rd.) color.

These symbols occupy one line and below them is space for any remarks to qualify the above general record. Upon the right half of the page observations like the following were recorded: "An even and thrifty lot of plants of medium size." "An average of five ripe fruits per plant in sight." "A very even-rowed set of fruits, which were a little inclined to crack upon the 'shoulder.'" "Seed was saved." Later, notes of inspection are made under the proper dates.

In this book the crosses are arranged so that all the members of a "family" are brought together, as they were in the field, which facilitates the study of crosses having the same "blood."

The five plants in the row of tomatoes are recorded as *a, b, c, d* and *e,* beginning at the upper or eastern end, and when the flowers of a selected plant are "hand-worked" (pollinated) within that plant—phyto-fertilized, as it might be termed—the record upon the wire-wood label indicates the fact by the letter which stands for the plant in the form of a fraction. Thus $\frac{d}{d}$ means that the seed secured was from plant *d* and fertilized with pollen from another flower of the same plant, while $\frac{a}{e}$ signifies that the pollen for a flower upon the lower or stake plant was obtained from the head plant in the row.

When each variety receives a number as it enters the breeding grounds, it is not difficult to keep a record of its combinations by the fractional method. For example, the "Currant" tomato, a separate species, the *Solanum pimpinellifolium* Dunal, when its seed was sown in the greenhouse, took the lowest unoccupied number for tomatoes, namely, 177, and this it must keep until the end. The books show this number in combination with several others, and the following are selected at random: $\frac{177}{144}$ This is the first generation—that is, the first set of plants from the cross—and the record shows that this combination with the little "Currant" tomato, with its slender vines and round, red fruits, when pollinated upon the "Golden Queen" (144), a large yellow-fruited variety, gives, to quote from the record book: "Enormous vines, with long clusters of cherry-red fruits." The "Currant" has great prepotency and dominates over the cultural varieties of the more common garden species. Again, $\begin{array}{c}177\\ \hline 128\\ \hline \text{II.}\end{array}$ is the second generation (indicated by Roman numeral below) of "Currant" upon "Sutton's Best of All," a fine, large, red-fruited, standard sort. This continues to give very large, long vines, abounding in long clusters of red fruits, averaging below an inch in diameter. In this way a "red plum" has been brought into existence, and it is to be predicted that the third and later generations will continue the same general character of long vines and clusters and small, round fruits, useful for pickling. Further, the book records a cross between two crosses, as shown by the following double fraction $\begin{array}{c}177\\ \hline 122\\ \hline\hline 75\\ \hline 103\end{array}$. Here the "Stone" (122), "Magnus" (75) and "Ponderosa" (103), are all combined with the "Currant" (177). The record shows that these "vines" were the largest upon the breeding grounds, with plants very uniform, bearing long, unbranched clusters of red fruits averaging one inch in diameter. It is to be remembered that the "Ponderosa" is one of the very large-fruited sorts, while "Stone" and "Magnus" are both of good, medium size, and yet the "quarter blood" of the small "Currant" was able to pull against the three and control the form of the fruit cluster and the type of the fruit. It illustrates that it is easier to drag down than to build up. It is also to be noted, in passing, that the red color of the "Currant" (and "Stone") prevails against the pink of both the "Magnus" and "Ponderosa."

Next season plants from this double cross, hand-worked within the combination, would be recorded upon the stake by the same fraction, with the addition of the Roman two (II.) below, thus:

$$\begin{array}{c}\dfrac{\dfrac{177}{122}}{\dfrac{75}{103}} \\ \text{II.}\end{array}.$$

Other vegetable fruits are treated in a similar manner as to record numbers. Thus each kind of truck crop under breeding trials has its own set of numbers, provided there is no hope of breeding them together. Thus sweet corn had numbers up to 105 before the subject of popcorn was added to the list, and as it may be desirable to breed these two groups together, the popcorns, of which thirty-six numbers were added this year, must be recorded from 106 to 142, to avoid any confusion. In the same way all kinds of beans, whether bush, pole, string or lima, come into the same series, although there is much less hope of a combination between the last two than elsewhere. All the squashes are numbered in the same series, but the breeding affinities are very distant between the two leading species represented.

The Marking of Stakes.

As experience is gathered from year to year, the importance of large, deeply-set stakes for all rows and special plants in the grounds becomes more and more emphasized.

When a plant is first set or a row planted with seeds a six-inch stake seems large enough, but plants increase and stakes decrease, or get trodden down, broken off or inexplicably mixed up, when there are workmen removing weeds and visitors of all kinds passing through the grounds. The only safe way is to set a stout stake at the head of each row before the plants are added or the seeds are dropped. These stakes need to be at least two feet long and driven in a little slanting toward the row, fully fourteen inches. They should be plainly marked before being placed where they are to remain during the life of the plants they record. The lettering—if names are employed—should be large and clear and lasting, that no doubt may arise from obscurity. Of course, there is a plotting of each block of plants recorded in the field-book of the crop, so that when labels are destroyed from any cause they can be replaced with certainty. The stakes, aside from giving the history of a cross by bearing the fraction above noted, are a means of recording certain events as to each row. For example, herbarium specimens are taken from each cross, and a mark, as "S," with a blue pencil, makes a convenient record upon the spot (stake) of the fact that the specimen has been secured. In the same way another mark indicates that seed from some specially early plant has been saved. Should it be desirable to mark the plant this may be done with a wooden wire-label or a larger one of cardboard—a shipping tag—when the plant is a leafy one and small labels are quickly overgrown. With squashes, for example, tall, white stakes, placed close by the side of plants to be designated, have proved a more acceptable guide in pollinating work than any kind of showy label that was devised. In fact, among beans and tomatoes, quickly-seen stakes are a great advantage in facilitating the work of getting quickly to the plants that are to receive special attention.

The following are some of the marks upon stakes and labels that have been in use upon the Gardens:

1. The Variety. The name in full with source—"Paragon" Liv.
2. The First Cross. A Fraction, the male parent as the numerator, $\frac{102}{113}$, for example ("Bismarck" upon "Detroit Wax" Bean).
3. The Compound Cross. A Compound Fraction $\frac{\frac{210}{169}}{\frac{75}{103}}$. This shows that the simple cross $\frac{210}{169}$, for example, "Station Yellow" tomato upon "Dwarf Stone" was crossed upon a cross of "Magnus" (75) upon "Ponderosa" (103).
4. Generation. Roman numeral below the fraction $\underset{\mathrm{III.}}{\frac{99}{19}}$, for example, "Black Mexican" sweet corn upon "Country Gentleman" during the third year for the cross.

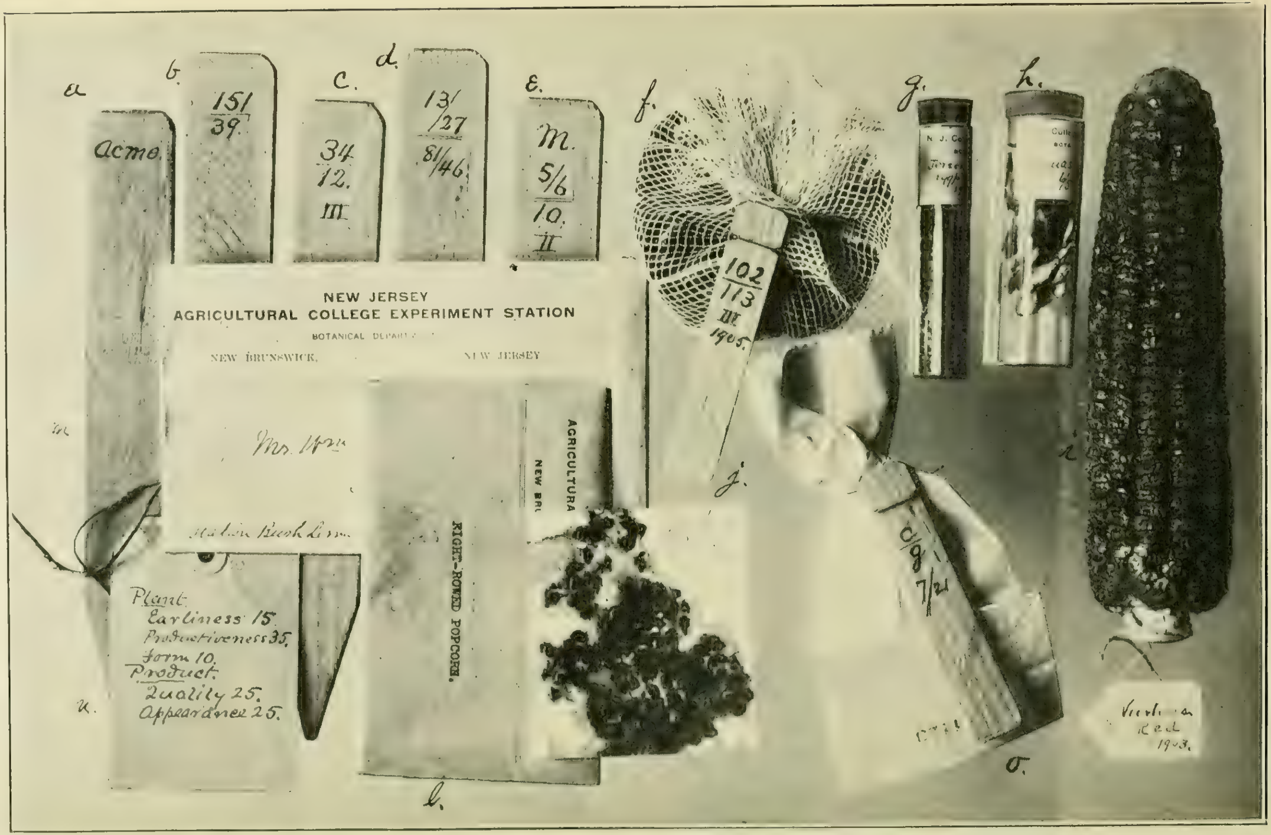
a
b.
c.
d.
e.
f.
g.
h.
i
j.
l.
m
n.
o.
Acme.
151/39.
34/12.
III
13/27
81/46
M.
5/6
10.
II
102/113
III
1905.
NEW JERSEY
AGRICULTURAL COLLEGE EXPERIMENT STATION
BOTANICAL DEPART
NEW BRUNSWICK, NEW JERSEY
Mr. Wm.
Plant.
Earliness 15.
Productiveness 35.
Form 10.
Product.
Quality 25.
Appearance 25.
EIGHT-ROWED POPCORN.
AGRICULTURA
NEW BR
c/8
7/21
N. J. Co
Red
1903.

PLATE XVI.

Stake Labels, Post Packets and Methods for Drying and Preserving Seeds.

5. Row Stakes. Capital Letter H. $\begin{array}{c}\frac{5}{6}\\ \hline\hline \frac{6}{5}\end{array}$, for example, shows the row filled with plants that are a compound cross of "Crookneck" (5) squash and "Scallop" (6). The large letter facilitates work in the field and in making records.
6. Plant in row. Italic Letter. For example, $\frac{6}{d}$; the second plant (b) is used to pollinate the fourth plant (d). This is used upon tie labels, and the plants are lettered from the upper or east end of the row, as for example, with tomatoes.
7. Quality. A Scale of Points upon a "shipping tag." Plant 50 (Earliness 15. Prolificness 35, Form 10). Product 50 (Quality 30, Appearance 20). This is used, for example, upon sweet corn, as a large tie label (shipping tag) during the growing season, and ears are saved for seed from the best plants thus recorded.
8. Signal Stakes. These tall, white stakes are used for marking conspicuously any row or plant for special treatment, and are much taller than the plants to be marked.

Somewhat in repetition of the previous remarks the following explanation of Plate XVI. is given: The largest variety stakes that are used upon the plots are about two feet long and three inches broad. In some instances the name of the variety only is written, in black paint, with fine brush. After a variety has been upon the books for some time its number may only be placed upon the stake, and when it is in a cross the number representing the male is written over that for the mother plant. Thus in the picture the $\frac{151}{39}$ stands for a row that bears cross-plants. When the cross is grown for a second crop a Roman numeral is placed below the fraction representing the cross. Thus in the third stake the plants thus marked are the third generation of 34 (whether beans, tomatoes, squashes, sweet corn or egg-plants, as the crop decides) upon number 12. When one cross is bred upon another cross the fact is recorded in the books and upon the stakes by placing one fraction (the male) over the other with two horizontal lines between. The number of horizontal lines indicates the number of new combinations.

If the double cross represented upon stake *d* was bred with a variety, or another cross, the fact could be quickly recorded by drawing three horizontal lines between the two sets of figures, and the portion above the three lines would be the male.

The same form of fractional record is employed in ticketing all seed packets. Fine mosquito netting has been found of great service in drying seeds like those of eggplants, squashes, etc., that are easily blown by the winds. At *f* is shown a packet of beans freshly shelled and drying, the wire-wood label indicating securely the cross, its generation and the year. The date of saving the seed is usually added to the label. For more permanent use the small seeds are placed in cork-stopper vials (*g* and *h*), with paster labels placed close to the cork, that as much of the seed as possible may be in sight. The sweet corn for special study is kept upon the ear by dipping the whole ear in melted paraffine to keep the grain from shelling. An ear thus preserved since 1903 is shown at *i*. Tomato seeds, fortunately, are surrounded with sufficient adhesive pulp so that they can be dried upon sheets of paper, to which they adhere, and may be marked as shown at *j*, which represents a sheet ready to be placed in a gum-flap packet shown below it (*l*) and marked for popcorn. The tomato seeds sheet shows that it is from the third generation of "Magnus-Ponderosa" (Magnerosa), and came from pollinating plant *a* with plant *d*, upon July 13th, and the seed was harvested August 26th. A mailing packet is shown near *m* and marked for "Station Bush" lima beans.

Other aids in the field work are large tickets (*n*), borne by the plants upon which from time to time notes are made to aid in selecting for earliness, productiveness, form of plant, these making up half of the hundred points in the "scale of points" for superior plants. An ordinary bag, with its wire-wood label marked to indicate a pollination, is shown at *o*. A row of beans sometimes is quite conspicuous because of these bags during the breeding season. After fertilization is secured the bag is torn open, but left upon the plant as a conspicuous mark.

INK PRINTS OF VEGETABLE FRUITS.

The serious difficulty in the way of making satisfactory records of the interior structure of soft fruits, like those of the tomato, has in part been overcome by resorting to ink prints. These prints are secured by cutting the fruit when full size, but not fully mature, and inking the cut surface after it has dried a little, and pressing the cut surface upon an ink pad of large size and applying the inked surface to white paper. It is quite essential to have a long knife with a broad blade and keen edge, that the surface may be very smooth and as nearly

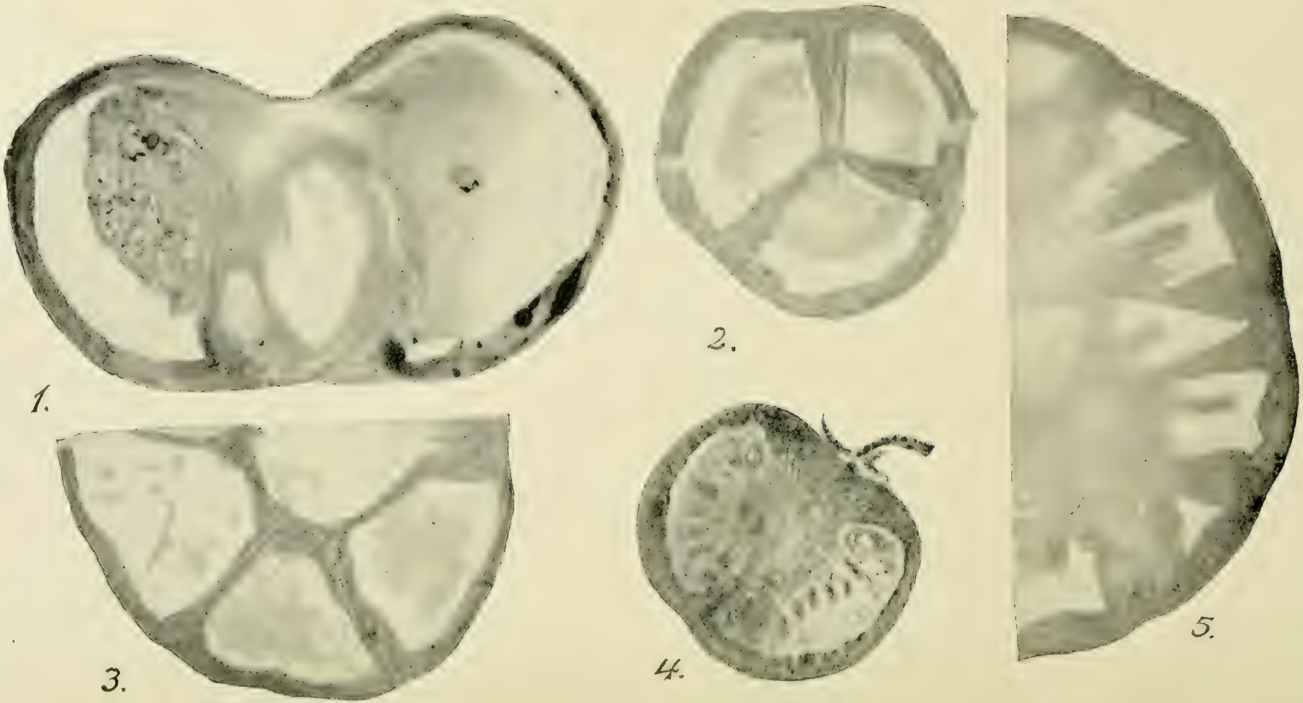

PLATE XVII.

Ink Prints of Tomatoes—*1*, "Crimson Cushion-Giant" upon "Giant"; *2*, No. 3151 U. S. D. A. (Italian), upon "Yellow Pear"; *3*, "Golden Queen" upon "Aristocrat-Golden Queen"; *4*, "Ignotum" upon "Red Plum"; *5*, same as No. *1* cut flatwise. All are natural size.

in one plane as possible. Black ink has proved more satisfactory than red or blue. It has been an advantage to stamp the section a few times upon refuse paper before the permanent print is made upon the sheets selected for preservation. Two sections have been taken of each fruit selected as a representative of the commercial sort or cross therefrom. Practically a full set of such prints for the tomatoes was secured the present season. It was found most convenient to first make a print of the axial section—that is, by cutting the fruit from stem to opposite end and then cut these two halves at right angles to the first printing surface and the axis of growth. A better print can be made by taking a separate fruit for each view, but experience shows that it is well to use the same fruit for both the longitudinal and the transverse print.

In the first-named section the width and depth of the fruit are shown; the wall, whether thick or thin, is clearly given, and something of the interior structure, while the transverse print gives more of detail of the interior of the fruit, as, for example, the number and size of the seed cavities (lodicels), the thickness of the partitions, and also of the outer wall, in addition to the size of the slice that may be taken across the fruit. Plate XVII. shows something of the nature of the ink-prints, samples of which were cut from the record sheets and reproduced in the engraving, natural size.

A similar set of prints was secured of the beans, in this case showing the pod cut lengthwise when fully grown, but immature, and a view of a section across the pod made through the middle of the seed and another between two adjoining seeds. Such a print records the exact size of the pod in length and width, while its thickness is given in the two transverse views. The number, size and location of the seeds are shown and made as to the thickness or fleshiness of the pod.

Squashes and eggplants can be similarly shown in section, while cucumbers lend themselves particularly to the making of such ink-prints. Sweet corn in transverse section of the ear, while young, is quite satisfactory as to many of the details. The list of subjects can be extended indefinitely.

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